FECAL COLIFORM TMDL DEVELOPMENT FOR SIX SEGMENTS IN THE BLACKWATER RIVER WATERSHED, FLORIDA

BIG COLDWATER CREEK
BIG JUNIPER CREEK
BLACKWATER RIVER
EAST FORK BIG COLDWATER CREEK
MANNING CREEK
WEST FORK BIG COLDWATER CREEK

Final

USEPA Region 4
61 Forsyth Street
Atlanta, GA 30303

February 2001

TOTAL MAXIMUM DAILY LOAD (TMDL) SUMMARY

NOTE: THESE FECAL COLIFORM TMDLs REQUIRE *NO LOAD REDUCTIONS* OVER CURRENT CONDITIONS TO MEET WATER QUALITY STANDARDS

(IN ALL CASES THE LOAD ALLOCATION (LA) IS EQUAL TO THE TOTAL EXISTING LOAD IN THE WATERSHED)

By definition: TMDL = WLAs + LAs + MOS

In terms of **concentration**:

Wasteload Allocation (WLA) = 0 fecal coliforms /100 ml
Load Allocation (LA) [+ Future Activities (Fut)] = 190 fecal coliforms /100 ml
Margin of Safety - explicit (MOS) = 10 fecal coliforms /100 ml

TMDL = WLA + LA + MOS + Fut = **200 fecal coliforms /100 ml**

In terms of **load**:

Big Coldwater Creek -- Map ID 96
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 7.80E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 5.12E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities = 1.93E+13 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **1.02E+14 fecal coliforms/30 days**

East Fork Big Coldwater Creek -- Map ID 53
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 8.25E+12 fecal coliforms/30 days
Margin of Safety (MOS) = 8.26E+11 fecal coliforms/30 days
Reserve for Future Growth/Activities = 7.48E+12 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **1.65E+13 fecal coliforms/30 days**

Manning Creek Map -- ID 59
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 6.38E+12 fecal coliforms/30 days
Margin of Safety (MOS) = 3.68E+11 fecal coliforms/30 days
Reserve for Future Growth/Activities = 6.22E+11 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **7.36E+12 fecal coliforms/30 days**

West Fork Big Coldwater Creek -- Map ID 42

Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 6.04E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 3.42E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities = 4.53E+12 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **6.83E+13 fecal coliforms/30 days**

Big Juniper Creek -- Map ID 84

Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 2.82E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 2.05E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities = 1.07E+13 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **4.09E+13 fecal coliforms/30 days**

Blackwater River -- Map ID 75

Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 2.33E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 1.8E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities = 1.14E+13 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **3.65E+13 fecal coliforms/30 days**

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

Levels of coliform bacteria can become elevated in waterbodies as a result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting designated uses even after technology-based controls are in place. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollutant sources and in-stream water quality conditions. By following the TMDL process, states can establish water quality-based controls to reduce pollution from both point and nonpoint sources and to restore and maintain the quality of their water resources (USEPA, 1991).

The Blackwater River watershed lies within the panhandle of northwest Florida, and its headwaters are in southern Alabama. The watershed is located almost entirely within Santa Rosa and Okaloosa counties in Florida with small portions in Escambia and Covington counties in Alabama (Figure 1-1). It is one of four major drainages of the Pensacola Bay system and flows into the Gulf of Mexico. The watershed is approximately 853 square miles (mi^2), with approximately 84 percent of that area (719 mi^2) in the state of Florida. The Blackwater River is designated for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Class III).

The Blackwater River and its tributaries have a total of eight segments listed as fecal coliform-impaired waterbodies on Florida's 1998 303(d) list, as adopted by the Florida Department of Environmental Protection (FDEP). The coliform impairment has resulted in nonattainment of designated uses, including recreation. This document develops TMDLs for six of the listed segments, including the East Fork, West Fork, Manning Creek, Big Juniper Creek, Big Coldwater Creek, and two segments of the Blackwater River. The companion document, "Fecal Coliform TMDL Development for One Segment in the Blackwater River Watershed, Blackwater River – Downstream Segment" develops a TMDL for the most downstream, riverine segment. The eighth listed segment, subject to estuarine influences, will have a TMDL developed for it at a later date.

Section 2 characterizes the study area, describes the designated uses associated with the resource, and identifies physical and land use characteristics. Section 3 inventories and evaluates relevant water quality data for the Blackwater River watershed. Section 4 identifies and characterizes the sources of fecal coliform with the Blackwater River watershed. Section 5 presents the modeling and analysis methodologies used to

link source loading and water quality response. Section 6 presents the elements of the TMDLs for the seven listed segments in the Blackwater River watershed.

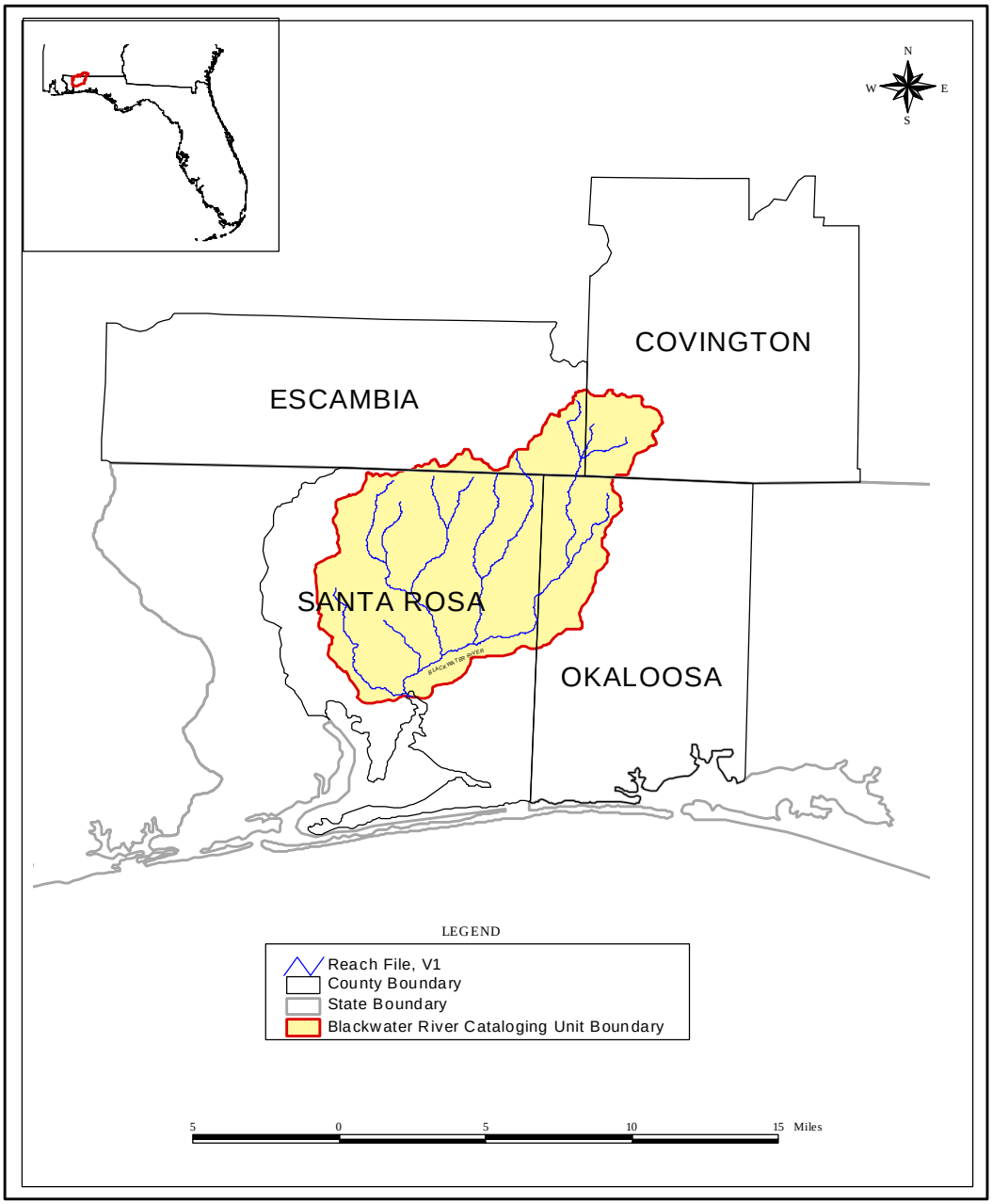

Figure 1-1. Location of the Blackwater River watershed

2. PHYSICAL CHARACTERISTICS

The purpose of this section is to characterize the Blackwater River watershed by identifying existing land uses, soils, topography, ecology, and land and resource management activities and by describing the water quality standards associated with this resource.

2.1 STUDY AREA

The listed segments are contained within the Blackwater River watershed, a drainage basin of approximately 853 mi^2, with approximately 719 mi^2 in Florida (Figure 2-1). The river originates in the Conecuh National Forest in southern Alabama. From the Florida-Alabama state line, it travels approximately 58 miles, with a gradient of 3.4 feet per mile, to Blackwater Bay and the Gulf of Mexico.

The Blackwater basin's sandy-bottom rivers are stained reddish-brown by tannic acids from swamp and forest drainage, which may account for its name. In general, the river is swift and shallow and is characterized by frequent sand bars (Hand, Col, and Lord, 1996). Groundwater from the Sand and Gravel Aquifer contributes a considerable amount of flow. The river system receives small contributions from surface flow; the primary source of flow is groundwater discharge (FDEP, 1998).

The major land uses within the basin are silviculture, agriculture, and preservation. The majority of the watershed is within the Blackwater State Forest and is managed by the Florida Department of Agriculture and Consumer Affairs, Division of Forestry. Numerous public and private recreation areas and facilities are directly or indirectly associated with the Blackwater River. The river, which flows through Blackwater State Forest and Blackwater State Park, is a favorite of canoeists and naturalists. Tourism continues to be a strong component of the area's economy, with fishing, hunting, hiking, and canoeing having long been mainstays of the region's economy (NWFWMD, 1996).

2.1.1 303(d)-Listed Segments

This TMDL study addresses six segments on the Blackwater or its tributaries identified on Florida's 1998 303(d) list as impaired by coliform bacteria (Figure 2-2). This subsection summarizes FDEP's descriptions for the coliform-impaired segments (FDEP, 1998).

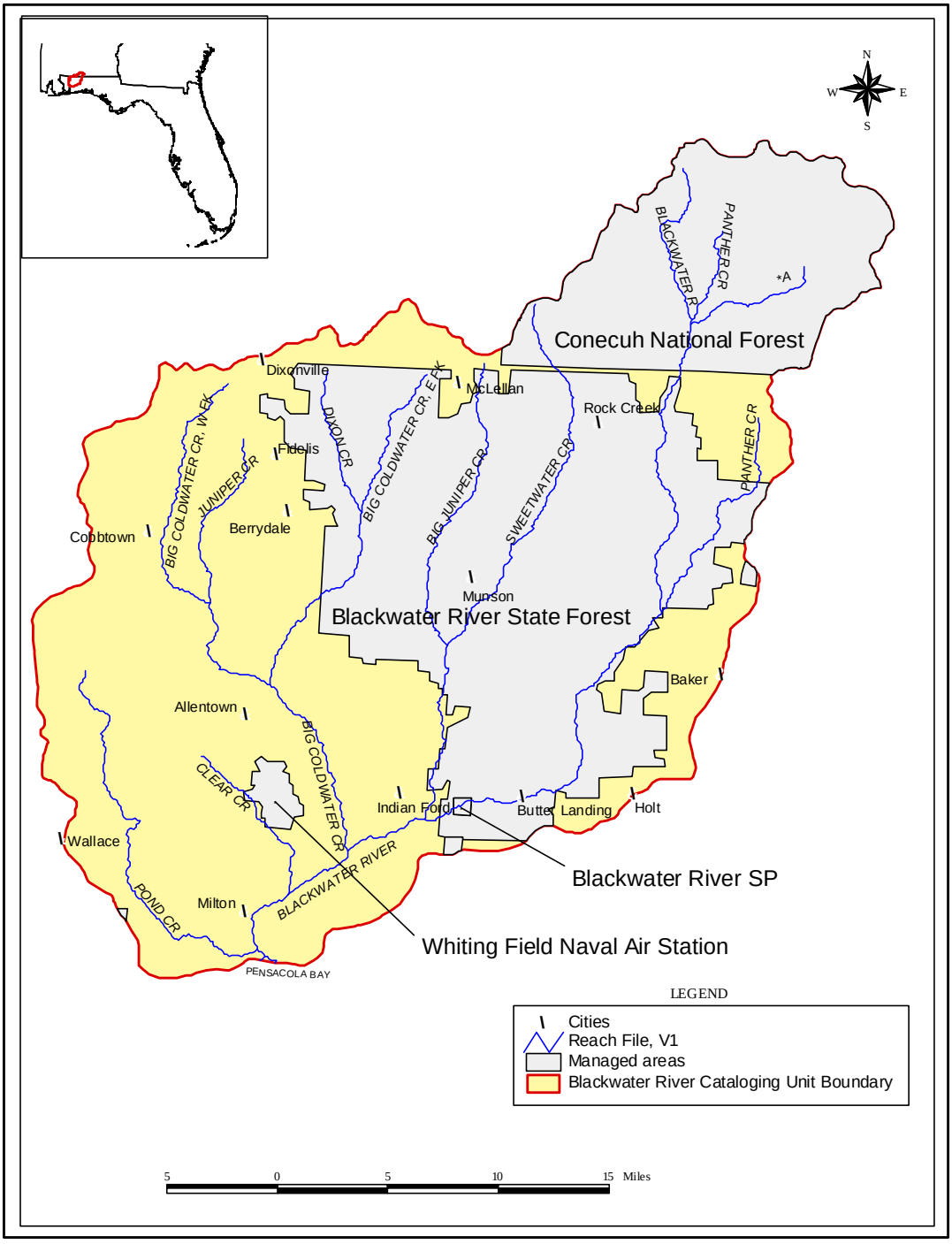

Figure 2-1. Blackwater River watershed

West Fork. West Fork Big Coldwater Creek is in northwest Santa Rosa County. Livestock, silviculture, and oil extraction/production facilities are present in its watershed. Coliform and nutrients are the water quality parameters of concern according to Florida's 1998 303(d) list.

East Fork. East Fork Big Coldwater Creek begins approximately 2 miles north of the Alabama-Florida state line. Most of its watershed drains land used for silviculture in the Blackwater State Forest and for agriculture near McClellan.

Manning Creek. Manning Creek is located within Santa Rosa County, flowing to the West Fork of Big Coldwater Creek approximately 4 miles north of Whiting Field. The watershed's land is used mostly for agriculture and silviculture.

Blackwater River. Originating north of Bradley, Alabama, the Blackwater River flows approximately 58 miles before entering Blackwater Bay in northwestern Florida. Although the river system has small contributions from surface runoff, the primary source of flow is groundwater discharged from the Sand and Gravel Aquifer.

Big Juniper Creek. Big Juniper Creek is located in northeast Santa Rosa County. Most of the watershed is within the Blackwater State Forest. A possible source of coliform within the watershed is agriculture.

Big Coldwater Creek. Big Coldwater Creek is located in Santa Rosa County. It drains approximately 237 mi^2 of silvicultural and agricultural lands that extend north of Milton to the Alabama-Florida state line. Sources of coliform may include livestock runoff and recreation (FDEP, 1998).

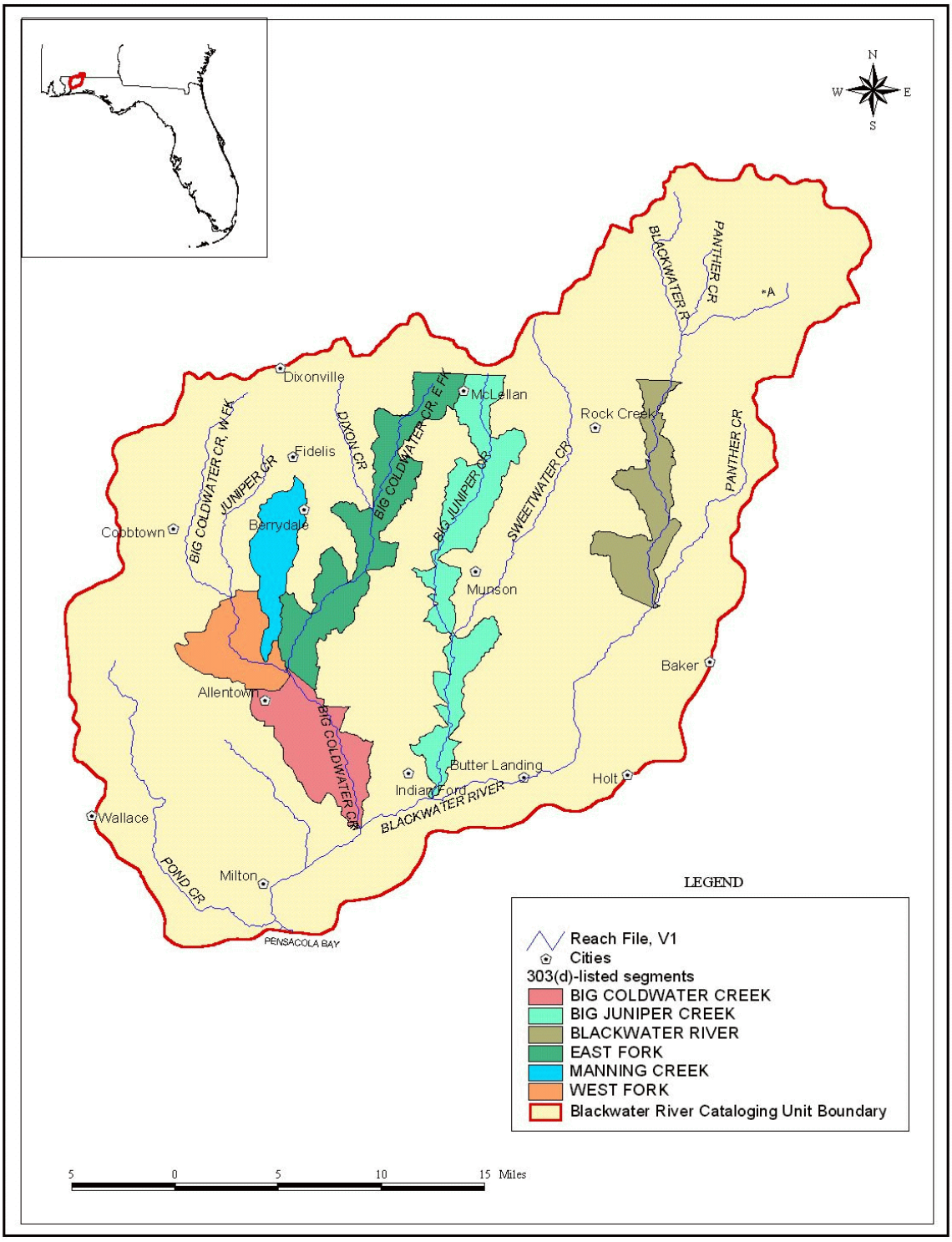

Figure 2-2. 303(d)-listed segments within the Blackwater River watershed

2.1.2 Topography, Geology, and Soils

Big Coldwater Creek, Big Juniper Creek, and the upper half of the Blackwater River drain low hills, while the lower half of the Blackwater's main stem and most of Pond Creek drain the coastal plain. Sand is the principal substrate type throughout the upper watershed. In the coastal plain, sand bottoms grade gradually into the sand/mud and mud bottom of the estuary (Bass and Hitt, 1977). The streambed itself is known as a shifting sand system.

Elevations in the Blackwater River watershed range from 3 feet to 374 feet. The watershed's mean elevation is 190 feet.

2.1.3 Climate

Northwest Florida has a mild, subtropical climate. Average annual temperatures tend to be in the upper 60s (degrees Fahrenheit), with mean summer temperatures reaching the low 80s and mean winter temperatures dropping to the low 50s (NWFWMD, 1998a). Northwest Florida Water Management District (NWFWMD) maintained monthly temperature summaries and means for Pensacola and Crestview for the 1961 through 1990 period of record (Table 2-1).

Average precipitation is 62 inches, with March, July, August, and September being the wettest months and October and November being the driest. Peak rainfall is typically measured in the summer, specifically July (NWFWMD, 1998b). NWFWMD has summarized rainfall data accumulated over 30 years (1961-1990) for its Milton, Pensacola, and Crestview weather stations (Table 2-2).

2.1.4 Land Use

Timber production and agriculture are important economic land use activities within the Blackwater River watershed. Most of the watershed is within Florida's Blackwater River State Forest, with the headwaters in the Conecuh National Forest in Alabama. The land surrounding the river is, therefore, relatively protected from development.

Table 2-1. Thirty-year monthly temperature summaries for the Blackwater River watershed

Month	Pensacola					Crestview				
	Monthly Avg. (FE)		Daily Extreme (FE)		Mean (FE)	Monthly Avg. (FE)		Daily Extreme (FE)		Mean (FE)
	Max	Min	High	Low		Max	Min	High	Low	
January	59.7	41.4	80	5	50.8	58.9	34.8	81	8	47.1
February	63.1	44.3	82	19	54.0	64.3	40.1	83	20	52.4
March	69.4	51.4	85	22	60.6	72.0	747.0	87	18	59.7
April	76.5	58.1	96	33	67.5	79.4	52.1	91	33	66.0
May	83.2	65.7	96	48	74.7	84.7	59.9	97	40	72.5
June	88.7	71.9	101	56	80.5	90.7	67.5	101	53	79.3
July	89.9	74.2	106	61	82.3	92.0	71.1	105	63	81.8
August	89.2	73.8	104	63	81.7	92.1	70.3	101	59	81.4
September	86.4	70.3	98	43	78.6	88.3	66.2	98	42	77.5
October	79.2	59.6	92	34	69.7	79.7	53.2	92	29	66.7
November	70.1	51.0	85	25	60.8	71.3	45.4	87	22	58.6
December	62.9	44.4	81	11	53.9	63.0	38.7	82	9	51.1
Annual Mean	-	-	-	-	67.9	-	-	-	-	66.2

Source: NWFWMD, 1998a.

FDEP provided land use coverages from 1995 for the Blackwater River watershed. The dominant land uses in the entire Blackwater River watershed are forest (approximately 70 percent), cropland/pasture (approximately 15 percent), and wetlands (approximately 11 percent). The 76 specific land use categories provided by FDEP were grouped into 8 broader categories for the TMDL analysis. Table A-1 in Appendix A contains a complete list of the Florida land use categories with the associated TMDL categories.

Because the Florida land use coverage did not cover the portion of the watershed in Alabama, it was necessary to use a different land use coverage for Alabama. A USGS Multiresolution Land Cover (MRLC, 1991-1993) data set was used for the Alabama land uses. The 12 MRLC land uses in the Alabama portion

of the watershed were grouped into the eight TMDL categories. Table A-1 in Appendix A also contains the MRLC categories and their associated TMDL categories.

Table 2-2. Thirty-year rainfall normals in northwest Florida

Month	Rainfall (inches)		
	Milton	**Pensacola**	**Crestview**
January	5.42	4.65	5.86
February	5.63	5.35	5.24
March	6.63	5.66	7.35
April	4.08	3.4	4.44
May	4.67	4.19	5.35
June	7.55	6.39	8.13
July	7.68	7.42	6.44
August	7.10	7.32	6.48
September	5.55	5.42	4.58
October	3.64	4.13	3.24
November	4.45	3.54	4.03
December	5.11	4.29	4.28
TOTAL	67.51	61.76	65.42

Source: NWFWMD, 1998b.

The reclassified land use categories used in the TMDL analysis are displayed in Figure 2-3. Table 2-3 summarizes the land use distribution in the watershed of each 303(d)-listed segment, using the TMDL categories. Table A-2 in Appendix A presents a complete list of land uses (i.e., Florida and MRLC categories) and their associated acreage.

2.1.5 Hydrology and Channel Morphology

The Blackwater River watershed receives small contributions of flow from surface runoff and relatively large contributions of flow from the Sand and Gravel Aquifer (FDEP, 1998). Data in Table 2-4 characterize the channel geometry and flow for the 303(d)-listed segments within the Blackwater River watershed. Data for Big Coldwater Creek, Big Juniper Creek, Blackwater River, and the East and West Forks of Big Coldwater

Creek come from Reach File, Version 1 (RF1); data for Manning creek come from Reach File, Version 3 (RF3). Reach lengths for Manning creek were obtained from RF3 attribute tables within BASINS, but other information is not available in RF3.

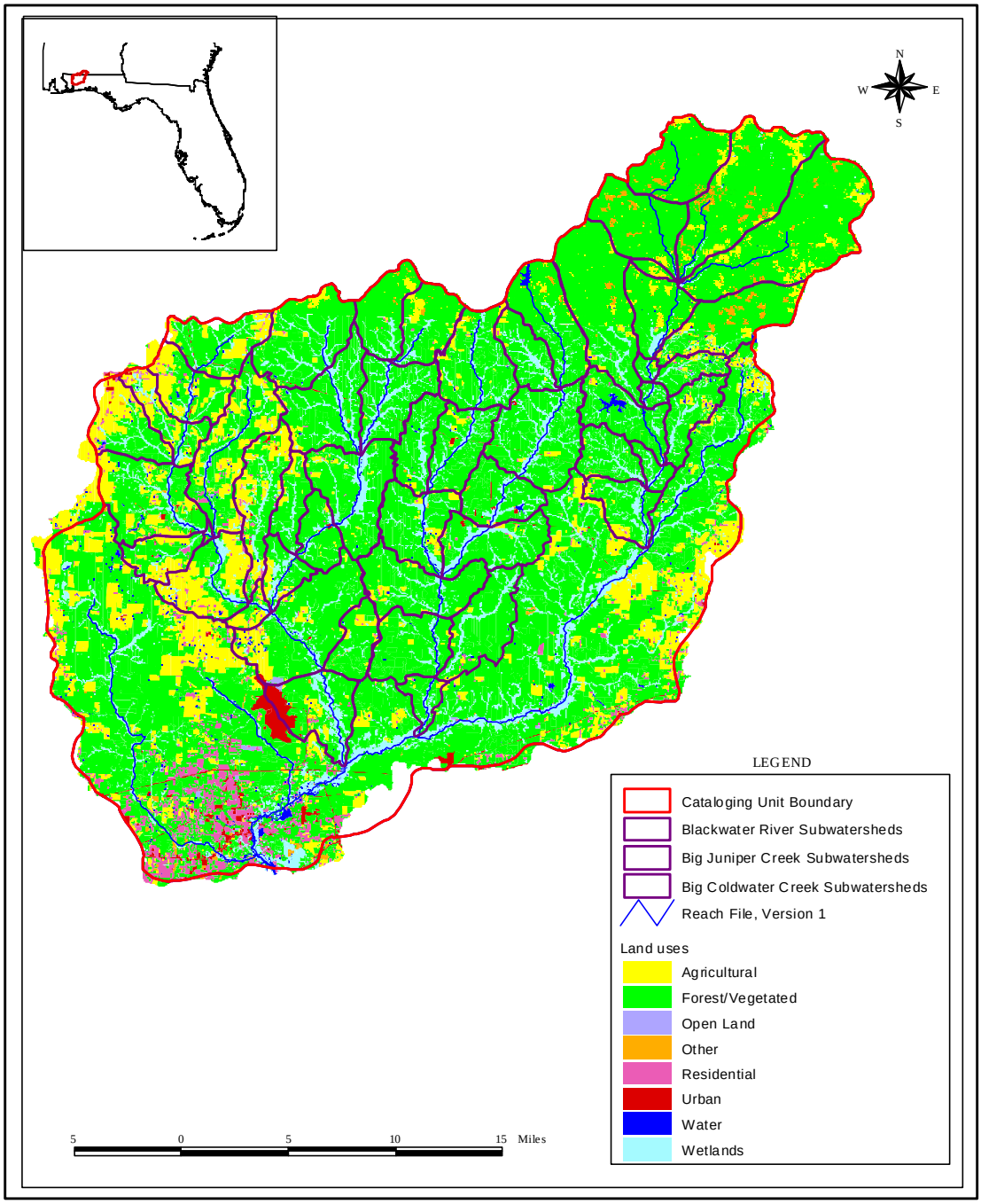

Figure 2-3. Land use within the Blackwater River watershed

Table 2-3. Land uses in the watersheds of 303(d)-listed segments of the Blackwater River watershed

Land Use	Big Coldwater Creek (acres)	Big Juniper Creek (acres)	Blackwater River (acres)	East Fork (acres)	Manning Creek (acres)	West Fork (acres)
Cropland[a]	23943.98	2475.95	4687.81	2783.48	2091.26	18829.68
Forest/Vegetated	97604.22	73274.01	89561.42	46262.63	3674.14	33260.40
Open Land	325.74	26.26	723.15	26.34	0.00	111.84
Other	437.98	217.11	3052.43	199.42	2.78	143.84
Pasture[a]	7775.99	1600.36	4551.45	988.91	669.06	6041.39
Residential	2196.40	342.90	268.82	182.05	327.89	1777.42
Urban	1644.83	313.49	66.68	129.28	97.22	501.33
Wetlands	17795.02	12297.91	4905.09	8783.48	896.11	6374.05
TOTAL	152616.27	90548.00	107816.85	59355.57	7758.47	67039.96

[a]Florida land use classification is "Cropland and Pasture." To separate into "Cropland" and "Pasture," the ratio of cropland and pasture from the 1997 Census of Agriculture for the appropriate counties was applied to the Florida classification.

Table 2-4. Reach File 1 channel geometry and flow information for the five segments in the Blackwater River watershed identified on Florida's 303(d) list as impaired for bacteria

Listed segment	Length (mile)	Mean flow (ft^3/s)	7Q10 (ft^3/s)	Slope	Mean depth (ft)	Mean width (ft)
Big Coldwater Creek	9.5	558.59	186.2	0.00066	1.83	88.95
Big Juniper Creek	24.5	125.49	15.45	0.0013	0.64	30.41
Blackwater River (upstream segment)	12.9	255.91	46.73	0.00064	1.08	54.10
East Fork Big Coldwater Creek	18.2	149.98	50.0	0.0015	1.05	40.68
West Fork Big Coldwater Creek	6.2	257.11	85.7	0.00079	1.39	59.35

2.2 RESOURCE MANAGEMENT ISSUES

The Blackwater River watershed area is contained within four counties in two states and traverses a national forest, a state forest, and a state park, making it subject to management by several federal, state, and local agencies.

2.2.1 Chapter 62, Florida Administrative Code

Water Quality Standards

Florida's surface water quality standards, as established in Chapter 62-302 of the Florida Administrative Code, vary according to a waterbody's surface water classification. The Blackwater River is a Class III freshwater waterbody designated to be used for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Water quality classifications are arranged in order of the degree of protection required: Class I waters generally have the most stringent water quality criteria and Class V waters generally have the least stringent. Criteria applicable to a classification are designed to maintain the minimum conditions needed to ensure the suitability of water for the designated use of the waterbody.

The Florida standard for bacteriological quality for fecal coliform bacteria specifies the following::

> The number per 100 mL (Most Probable Number [MPN] or membrane filter [MF] counts) shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period (Chapter 62-302.530 F.A.C.).

Outstanding Florida Waters Designation

Chapter 62-302.700 of the Florida Administrative Code (F.A.C.) affords special protection to waterbodies designated by Florida as Outstanding Florida Waters (OFW) or Outstanding National Resource Waters (ONRW). Under this designation no degradation of water quality, other than that allowed in Rule 62-4.242(2) and (3), F.A.C., is to be permitted. The Blackwater River is afforded special protection under Chapter 62-302.700 because of its designation as a Special Water and an OFW.

2.2.2 State Resource Management Agencies

Florida Department of Environmental Protection

The FDEP is Florida's principal environmental and natural resources agency. It is responsible for regulating air, water, wastewater, storm water, and hazardous waste pollution through a permitting and certification process. FDEP implements the OFW program, enforces water quality standards, and administers aquatic preserves. Its mission is to protect, conserve, and manage Florida's environment and natural resources. FDEP accomplishes its mission in a manner that

- Provides stewardship of Florida's ecosystems so that the state's unique quality of life may be preserved for present and future generations.
- Protects the public health and safety.
- Provides for the responsible and wise use of the state's mineral, cultural and living resources.
- Provides efficient and equitable service to the public.
- Provides consistent and impartial implementation of the law.

FDEP's Northwest District office, located in Pensacola, facilitates management of the Blackwater River system.

Pensacola Bay Ecosystem Management Area. The Blackwater River watershed lies within the Pensacola Bay Ecosystem Management Area (EMA). This EMA is managed by a group of elected local officials acting as a coordinating council under the name Bay Area Resource Council (BARC). A Citizens Advisory Committee (CAC) and a Technical Advisory Committee have suggested that the BARC put together a team to evaluate sampling data and put it in a form so it can be displayed on an Internet site and made available to all who are interested. The CAC is also developing ideas on septic tank ordinances, impact fees for large developments, and storm water management.

Blackwater Heritage State Trail (Rails to Trails). This is a greenways project that will provide a corridor between the Blackwater Forest and the city of Milton. An abandoned railroad is being converted to a walking and bicycle trail.

Blackwater River State Park. The Blackwater River State Park is a 590-acre state park in Florida. With three hiking trails and 30 campsites, the park attracts canoeists, hikers, and outdoor enthusiasts. Hunting, livestock grazing, and timber removal are prohibited within the park.

Northwest Florida Water Management District

Since its establishment in 1972, the NWFWMD has been involved in efforts to understand and appropriately manage northwest Florida's water resources. Research and management efforts have included studies of sedimentation, fish populations, thermal anomalies, and submerged vegetation in the effort to manage lands to facilitate the conservation and restoration of their natural, aesthetic, hydrologic, and recreational values.

Florida Department of Agriculture and Consumer Services

The Florida Department of Agriculture and Consumer Services (DACS) is responsible for regulating the purchase and use of restricted pesticides. It also assists the federal Natural Resources Conservation Service (NRCS) with soil and water conservation.

Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FFWCC) has regulatory and management jurisdiction over game and nongame wildlife and freshwater aquatic life.

Alabama State Agencies

Alabama agencies responsible for management of the Blackwater River watershed include the Alabama Department of Environmental Management, the Department of Conservation and Natural Resources, and the Game and Fish Division of the Department of Conservation and Natural Resources.

2.2.3 Federal Resource Management Agencies

Federal laws relevant to the Blackwater River basin include the National Flood Insurance Act of 1968, Clean Water Act of 1977 (amended 1987), National Environmental Policy Act of 1969, and Endangered Species Act of 1973 as amended. Federal agencies responsible for implementing these laws include the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), U.S. Air Force, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency (EPA).

3. INVENTORY OF WATERSHED INFORMATION

This section presents an overview of the in-stream water quality monitoring data for the Blackwater River and discusses potential point and nonpoint sources of fecal coliform loading. The purpose is to inventory available data that are appropriate to use in developing a coliform TMDL. Water quality data related to coliform bacteria for the Blackwater River watershed were collected from EPA's STORET database.

3.1 EXISTING MONITORING AND FIELD ASSESSMENT DATA

3.1.1 Water Quality Data

A number of state and federal agencies have conducted water quality monitoring within the Blackwater River watershed since the 1960's. EPA, USFS, USGS, FDEP, and NWFWMD have all monitored for fecal coliform bacteria.

A comprehensive search for the Blackwater River watershed was conducted in EPA's STORET database, which includes data from USGS, EPA Region 4, FDEP, USFS, and NWFWMD databases. Sixty existing or past monitoring stations within the entire Blackwater River watershed have at least one observation of fecal coliform reported in STORET. Data used to evaluate general water quality conditions over the entire Blackwater River watershed were limited to data collected at stations with a minimum of five data points for fecal coliform between 1980 and 1998. Using this criterion, data from 19 of the 60 monitoring stations were evaluated to assess current water quality conditions in the entire watershed. Ten of the 19 stations are located within the watersheds of the listed segments. (Although it does not have at least five data points after from 1980 to 1998, an additional stations [304809087023201] was included in the analysis because it is the only station with data for Manning Creek, respectively.) The stations are displayed in Figure 3-1.

3.1.2 Flow Data

There are 10 USGS flow gaging stations within the Blackwater River watershed. Table 3-1 provides an inventory of the USGS gages within the watershed. Also listed in the table is the period of record of available continuous daily flow data.

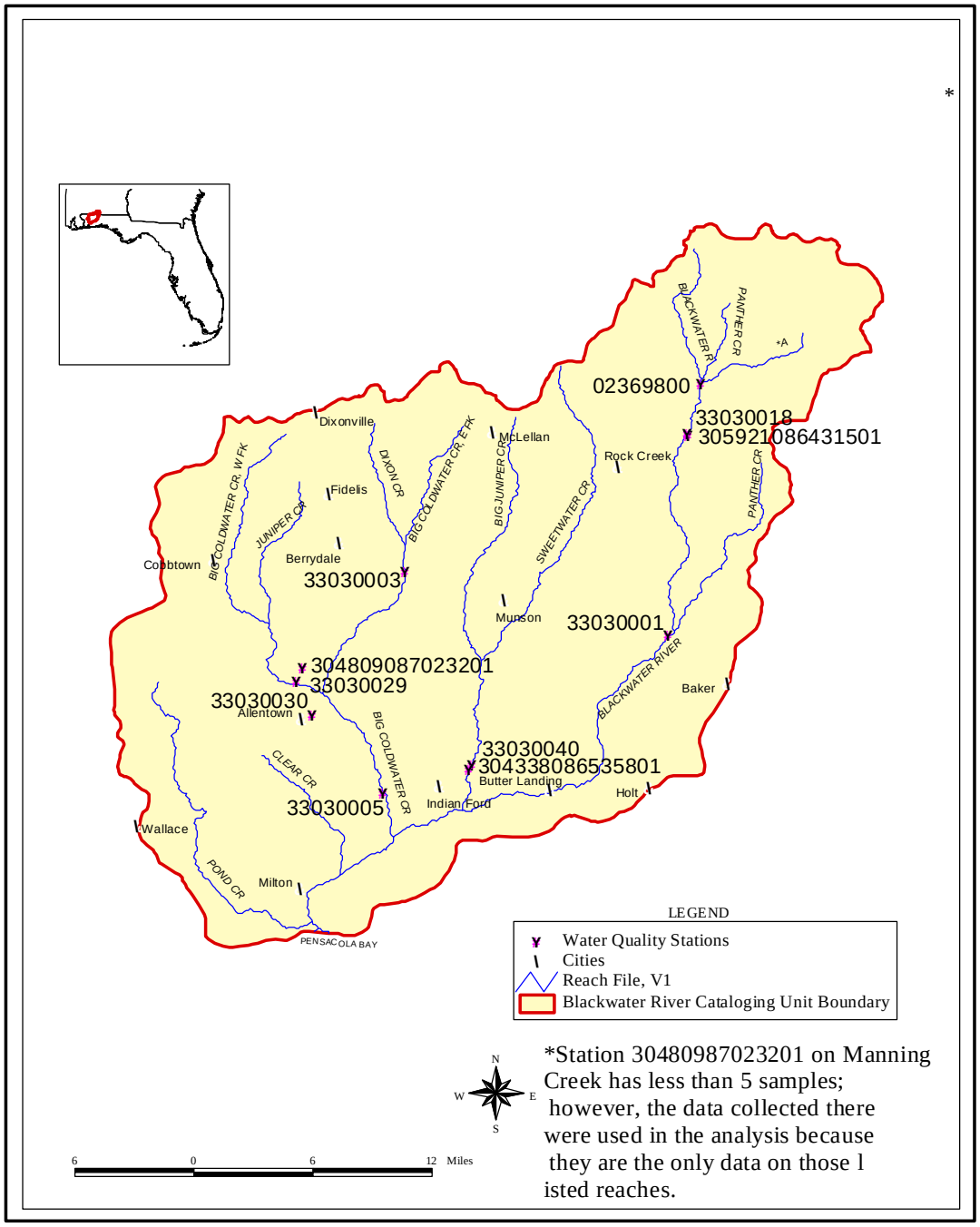

Figure 3-1. Water quality monitoring stations within the Blackwater River watershed, with at least 5 fecal coliform data points from 1980 to 1998

Table 3-1. USGS flow gages within the Blackwater River watershed

Station No.	Station Name	County	Period of Record[a]
02370000	Blackwater River near Baker, FL	Okaloosa	4/1/50-11/30/92; 10/1/96-9/30/97
02370015	Muddy Branch near Beaver Creek, FL	Okaloosa	n/a[b]
02370200	Big Juniper Creek near Munson, FL	Santa Rosa	1/1/58-12/31/66
02370250	Big Juniper Creek near Spring Hill, FL	Santa Rosa	n/a[a]
02370300	West Fork Big Coldwater River at Cobbtown, FL	Santa Rosa	1/1/58-12/31/61
02370500	Big Coldwater Creek near Milton, FL	Santa Rosa	12/1/38-6/11/79; 2/13/80-4/22/80; 7/15/80-3/3/92
02370550	Clear Creek near Milton, FL	Santa Rosa	n/a[b]
02370700	Pond Creek near Milton, FL	Santa Rosa	1/1/58-11/30/78; 1/16/79-7/11/79
02370750	Hurricane Branch near Milton, FL	Santa Rosa	n/a[b]
02369800	Blackwater River near Bradley, AL	Escambia	10/1/67-9/30/97

[a] Period of record for daily flow data. Does not include peak flow data.
[b] Only peak flow data are available for this station.

3.2 ASSESSMENT OF WATER QUALITY CONDITIONS

Data from the 11 stations discussed in Section 3.1.1 were used to evaluate water quality conditions in the watersheds of the listed segments. Table 3-2 summarizes the water quality data collected at the 11 monitoring stations, including minimum, median, and maximum fecal coliform levels, as well as the percent of collected samples that violate water quality standards. Data were compared to the instantaneous criteria in the state water quality standards—no sample to exceed 800 cfu/100 mL at any time for fecal coliform. The actual data used in evaluating the water quality in the Blackwater River watershed are presented in tables B-1 through B-6 in Appendix B.

Table 3-2. Summary of in-stream fecal coliform data collected at monitoring stations (with at least 5 samples from 1980 to 1998) on 303(d)-listed segments

Station	Location	Period of Record	No. of Samples	Min	Median	Max	Violations of WQS	Percent Violating[a]
Blackwater River								
02369800	Blackwater River near Bradley, AL	12/9/83-8/14/91	23 [b]	23	78	1,000	1	4.35
33030018	Blackwater River at Wood Bridge, Hwy 180	7/11/93-1/26/98	17 [c]	10	50	400	0	0
305921086431501	Blackwater River at Hwy 180	12/7/92-8/24/94	9	1	16	120	0	0
33030001	Blackwater River at Hwy 4 near Baker	5/6/80-3/13/96	99	0	50	61,000	12	12.1
Big Juniper Creek								
33030040	Big Juniper Creek at Indian Ford Rd.	1/6/91-1/26/98	36	10	60	3,200	1	2.8
304338086535801	Big Juniper Creek at Blackwater River	3/10/92-8/24/94	7	24	140	1,200	1	14.3
Big Coldwater Creek								
33030030	Big Coldwater Creek, Jct of East and West Forks	8/13/80-1/26/98	27	10	60	540	0	0
33030005	Big Coldwater Creek, Hwy 191 near Milton	9/17/89-1/26/98	46	10	70	3,900	4	8.7
West Fork Big Coldwater Creek								
33030029	Coldwater Creek at Hwy 87	8/26/80-1/26/98	26	10	85	1,600	1	3.8
East Fork Big Coldwater Creek								
33030003	East Fork Big Coldwater Creek, Hwy 4	9/10/89-1/26/98	26	10	30	300	0	0
Manning Creek								
304809087023201[d]	Manning Creek at Big Coldwater Creek	3/10/92-9/17/92	3	400	2,800	75,000	2	67

[a] Percent of samples that violate water quality standards.

[b] Value may be underestimated because for some samples, the actual sample value is unknown but is known to be greater than the value reported.

[c] Some samples were excluded from statistical analysis because too many colonies were present to count. The value reported represents the filtration volume.

[d] Station does not have at least five samples collected from 1980 to 1998; data are presented because they are the only data available for this segment.

4. SOURCE ASSESSMENT

Potential sources of coliform bacteria are numerous and often occur in combination. Potential point sources include poorly treated municipal sewage, urban storm water runoff, sanitary sewer overflows, combined sewer overflows (CSOs), and untreated domestic sewage. Potential nonpoint sources include manure disposal and runoff of animal waste from feedlots, disposal and handling of poultry litter, failing or ill-sited septic systems, runoff from pasturelands, application of manure or municipal sludge to cropland and other agricultural areas, and loadings from various wildlife species.

4.1 ASSESSMENT OF POINT SOURCES

A significant potential source of human fecal coliform from point sources is raw sewage. Raw sewage typically has a fecal coliform count of 10^6 to 10^8/100mL (Metcalf & Eddy, 1991), along with significant concentrations of viruses, protozoans, and other parasites. Typical treatment in a municipal plant reduces the total coliform count in effluent by about three orders of magnitude, to the range of 10^4 to 10^6 MPN/100 mL. Raw sewage, although usually not discharged intentionally, can reach waterbodies through leaks in sanitary sewer systems, overflows from surcharged sanitary sewers (non-combined sewers), illicit connections of sanitary sewers to storm sewer collection systems, or unidentified broken sewer lines.

EPA's permit compliance system (PCS) files were queried to identify and characterize any point sources discharging fecal coliform bacteria within the watersheds of the seven listed segments in the Blackwater River. No point sources were identified as present within any of the watersheds.

4.2 ASSESSMENT OF NONPOINT SOURCES

Nonpoint sources of fecal coliform bacteria are typically separated into urban and rural components. Urban settings are typically characterized by larger areas of paved impervious surfaces. Important sources of coliform loads in urban areas are storm runoff from impervious areas, failing septic tanks, and leaking sanitary sewer systems. In rural settings, the amount of impervious area is usually much lower, resulting in greater infiltration of precipitation and less runoff. Sources of fecal coliform in rural areas may include runoff from fields receiving land application of animal wastes, runoff from concentrated animal operations, contributions from wildlife, cattle in the stream, and failing septic tanks (IFAS, 1998).

The watersheds of the 303(d)-listed segments were divided into subwatersheds to spatially evaluate pollutant sources and loading and to more accurately represent the stream systems by isolating main tributaries and

stream segments. Florida provided GIS data layers of delineated subwatersheds for the state, providing a basis for subwatershed delineation for this study. Each listed watershed was evaluated and subwatersheds were determined based on the Florida subwatersheds, the location of monitoring stations, and the distribution of land use. Figures 4-1 through 4-3 present the subwatersheds for each of the 303(d)-listed segments evaluated in this study for the Blackwater River watershed.

Some of the listed segments are tributaries to other listed segments (Figures 4-1, 4-2, and 4-3). Therefore, some listed segments are delineated within the larger watershed. For example, the watershed for Big Coldwater Creek includes the watersheds for three other listed segments— East Fork, West Fork, and Manning Creek. Table 4-1 contains a listing of the subwatersheds included in the watersheds for the listed segments. The table presents the subwatersheds that are included in multiple listed watersheds; for example, all of the subwatersheds in the West Fork watershed are also included in the watershed for the entire Big Coldwater Creek. Big Coldwater Creek was delineated into 23 subwatersheds, including 9 subwatersheds in the East Fork watershed, 11 subwatersheds in the West Fork watershed and 1 subwatershed for the Manning Creek watershed. Blackwater River watershed was delineated into 15 subwatersheds. Big Juniper Creek watershed was delineated into 13 subwatersheds.

Watershed information available for the Blackwater River watershed was evaluated to identify and quantify sources of bacteria within the watersheds of the listed segments. The identified nonpoint sources of fecal coliform bacteria within the watersheds of the listed segments include

- Runoff from pasturelands with grazing livestock
- Runoff from cropland
- Failing septic systems
- Wildlife contributions
- Cattle in the stream.

Other sources include runoff from residential and urban areas. The following sections provide information on the characterization and quantification of bacteria sources within each listed watershed.

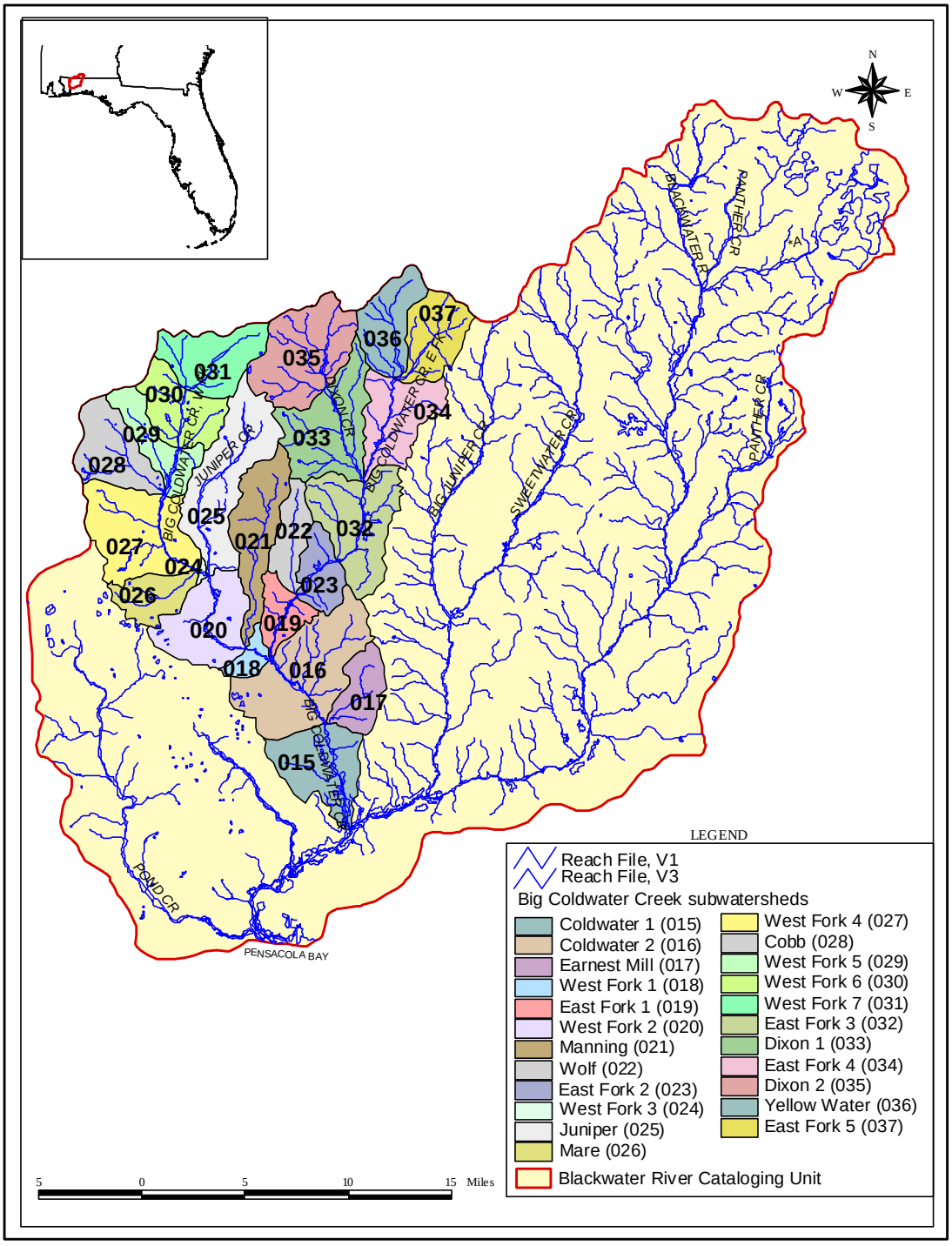

Figure 4-1. Subwatersheds within the Big Coldwater Creek watershed

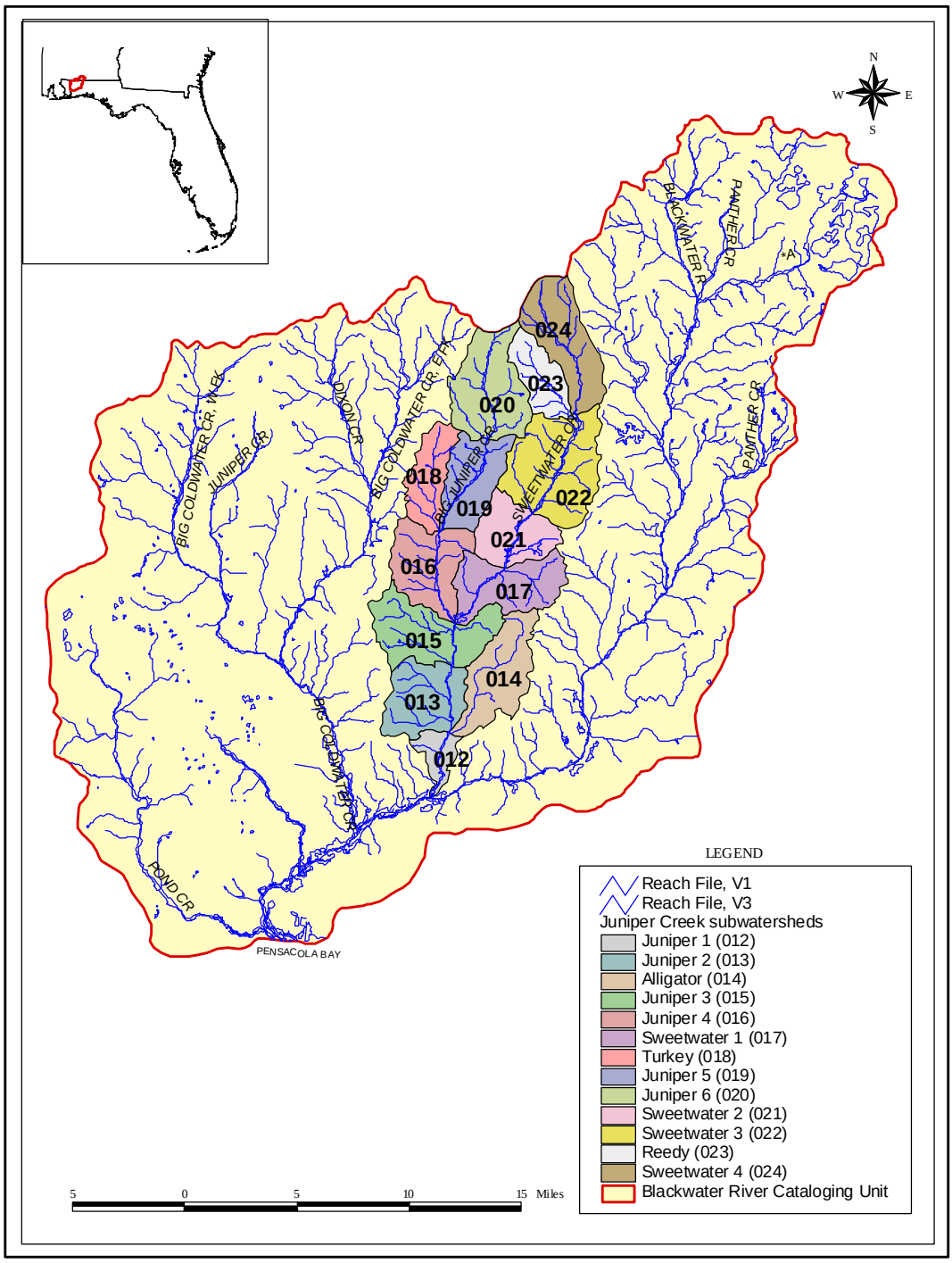

Figure 4-2. Subwatersheds within the Big Juniper Creek watershed

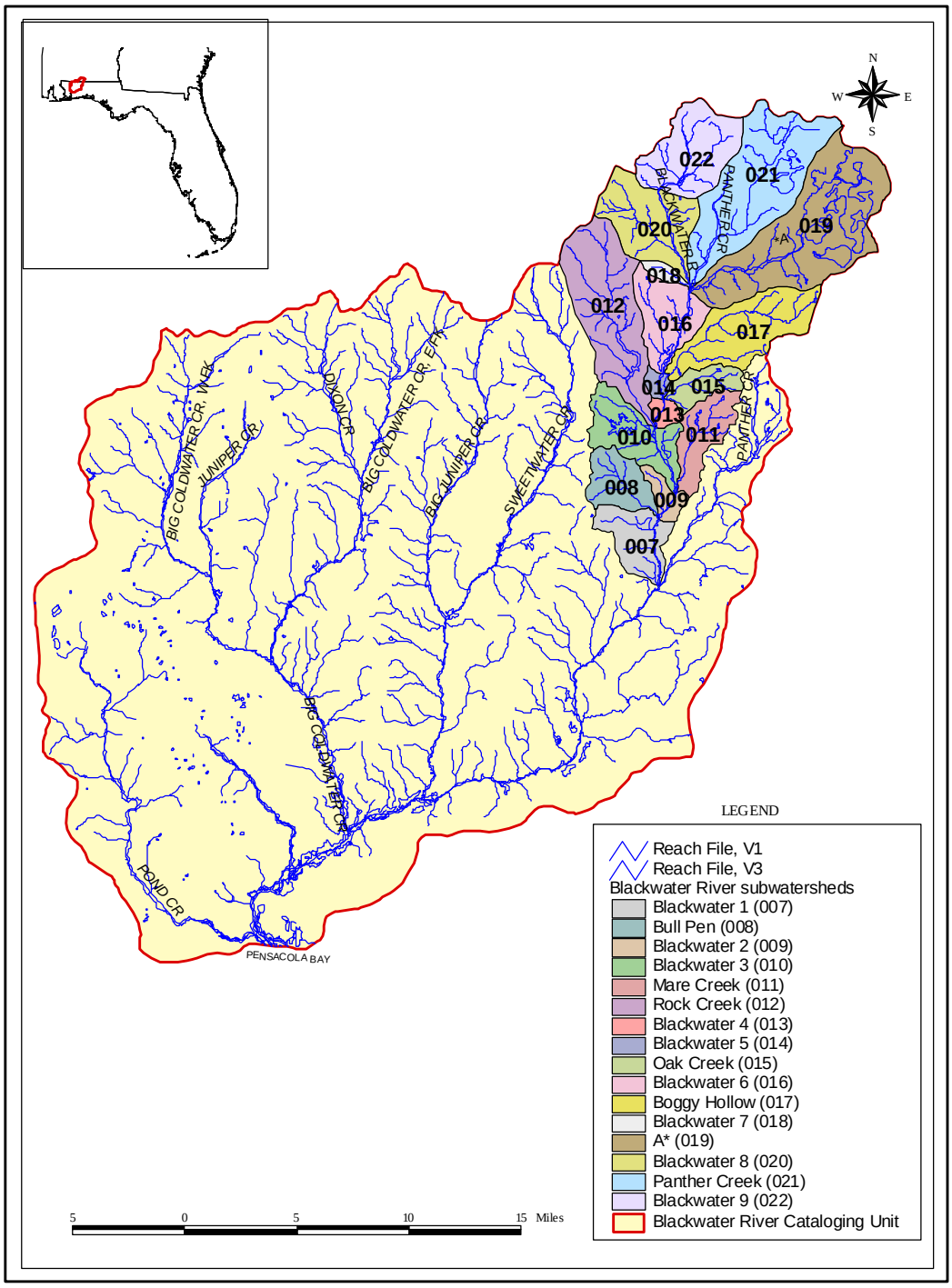

Figure 4-3. Subwatersheds within the Blackwater River watershed

Table 4-1. Subwatershed distribution among listed watersheds

Big Coldwater Creek						Blackwater River			Big Juniper Creek		
ID	Subwatershed	Big Coldwater Creek	East Fork	West Fork	Manning Creek	ID	Subwatershed	Blackwater River	ID	Subwatershed	Big Juniper Creek
015	Coldwater 1	U				007	Blackwater 1	U	012	Juniper 1	U
016	Coldwater 2	U				008	Bull Pen	U	013	Juniper 2	U
017	Earnest Mill	U				009	Blackwater 2	U	014	Alligator	U
018	West Fork 1	U		U		010	Blackwater 3	U	015	Juniper 3	U
019	East Fork 1	U	U			011	Rock Creek	U	016	Juniper 4	U
020	West Fork 2	U		U		012	Blackwater 4	U	017	Sweetwater 1	U
021	Manning	U		U	U	013	Blackwater 5	U	018	Turkey	U
022	Wolf	U	U			014	Oak Creek	U	019	Juniper 5	U
023	East Fork 2	U	U			015	Blackwater 6	U	020	Juniper 6	U
024	West Fork 3	U		U		016	Boggy Hollow	U	021	Sweetwater 2	U
025	Juniper	U		U		017	Blackwater 7	U	022	Sweetwater 3	U
027	West Fork 4	U		U		018	A*	U	023	Reedy	U
028	Cobb	U		U		019	Blackwater 8	U	024	Sweetwater 4	U
029	West Fork 5	U		U		020	Panther Creek	U			
030	West Fork 6	U		U		021	Blackwater 9	U			
031	West Fork 7	U		U							
032	East Fork 3	U	U								
033	Dixon 1	U	U								
034	East Fork 4	U	U								
035	Dixon 2	U	U								
036	Yellow Water	U	U								
037	East Fork 5	U	U								

4.2.1 Grazing Livestock

Grazing cattle and other agricultural animals deposit manure and, therefore, fecal coliform on the land surface, where it is available for washoff and delivery to receiving waterbodies. Grazing animals in the watersheds of the Blackwater River contribute fecal coliform accumulation to the Pasture land use. Data from the 1997 Census of Agriculture provided numbers of livestock in each county covering portions of the

watersheds, as well as total pastureland within each county. The livestock counts and pasture areas were used to determine livestock densities (e.g., number of cows per acres of pastureland) for each county, assuming livestock are evenly distributed over pasture area in the county. The area of pastureland in each subwatershed and within each county was determined using GIS data layers. The pasture area of the subwatershed within each county and the livestock density for the counties were used to calculate the livestock counts within the portion of the subwatershed intersecting that county. That is to say, each county has a unique livestock density that was applied to the portion of the subwatershed within that county. The county/subwatershed livestock estimates were then summed to determine livestock counts for the entire subwatershed. For example, the Blackwater 6 subwatershed of the Blackwater River watershed has 37 acres of pastureland in Okaloosa County, Florida, and 172 acres of pastureland in Escambia County, Alabama. The density of beef cows is 0.17 cows/acre in Okaloosa County and 0.32 cows/acre in Escambia County. Therefore, the total number of beef cows in the Blackwater 6 subwatershed is

37 acres x 0.173 cows/acre + 172 acres x 0.322 cows/acre = 62 cows

The subwatershed livestock counts are presented in the following sections for the major listed watersheds. Therefore, subwatersheds that are contained in more than one listed watershed (e.g., West Fork 1 in the West Fork watershed and Big Coldwater Creek watershed) are presented only once.

Estimates for hogs and chickens are included in the following tables although originally it was assumed that there are not many hog or chicken farms in the watersheds based on personal communication with NRCS. Therefore, hogs and chickens are not considered to be significant sources of fecal coliform bacteria to the waterbodies. Also the counties of Escambia, Covington, Jackson, and Walton did not have Ag Census data for chickens, so the watersheds in those respective counties do not have livestock counts for chickens.

Big Coldwater Creek (including West Fork, East Fork, and Manning Creek)

Table 4-2 presents the livestock counts for each subwatershed within the Big Coldwater Creek watershed.

Table 4-2. Livestock counts for subwatersheds within the Big Coldwater Creek watershed

ID	Subwatershed	Pasture (acres)	Cattle/ Calves	Beef Cows[a, b]	Milk Cows[a, b]	Sheep/ Lambs[a]	Horses	Hogs	Chickens
015	Coldwater 1	129.10	59	30	1	1	3	2	4
016	Coldwater 2	512.09	329	165	10	0	7	25	0
017	Earnest Mill	104.51	48	25	0	1	2	1	3

ID	Subwatershed	Pasture (acres)	Cattle/ Calves	Beef Cows[a, b]	Milk Cows[a, b]	Sheep/ Lambs[a]	Horses	Hogs	Chickens
018	West Fork 1	189.24	86	44	1	2	4	3	5
019	East Fork 1	131.76	60	31	1	1	3	2	4
020	West Fork 2	1105.95	504	260	5	9	24	15	30
021	Manning	669.06	305	157	3	5	14	9	18
022	Wolf	126.39	58	30	1	1	3	2	3
023	East Fork 2	19.64	9	5	0	0	0	0	1
024	West Fork 3	0.00	0	0	0	0	0	0	0
025	Juniper	880.74	401	207	4	7	19	12	24
026	West Fork 4	660.87	301	155	3	5	14	9	18
027	Cobb	654.42	420	211	13	0	8	32	0
028	West Fork 5	481.05	219	113	2	4	10	7	13
029	West Fork 6	619.94	282	145	3	5	13	9	17
030	West Fork 7	423.39	194	100	2	3	9	6	12
031	East Fork 3	100.12	46	23	0	1	2	1	3
032	Dixon 1	104.97	48	25	0	1	2	1	3
033	East Fork 4	14.47	7	3	0	0	0	0	0
034	Dixon 2	256.62	146	74	4	1	4	9	3
035	Yellow Water	58.06	36	18	1	0	1	3	0
036	East Fork 5	176.88	101	126	2	1	3	6	2
TOTAL		7776	3821	2031	58	51	153	159	173

[a] Numbers for beef cows, milk cows, and sheep were not available in the Census of Agriculture for Escambia County, AL, for 1997. Counts used to calculate livestock in subwatershed portions within Escambia County represent 1992 data.

[b] Numbers for beef cows and milk cows were not available in the Census of Agriculture for Santa Rosa County, FL, for 1997 or 1992. Counts used to calculate livestock in subwatershed portions within Santa Rosa County represent 1987 data.

Big Juniper Creek

Table 4-3 presents the livestock counts for each subwatershed within the Big Juniper Creek watershed.

Table 4-3. Livestock counts for subwatersheds within the Big Juniper Creek watershed

ID	Subwatershed	Pasture (acres)	Cattle/ Calves	Beef Cows[a, b]	Milk cows[a, b]	Sheep/ lambs[a]	Horses	Hogs	Chickens
012	Juniper 1	47.14	21	11	0	0	1	1	1
013	Juniper 2	111.57	51	26	0	1	2	2	3
014	Alligator	113.90	52	27	0	1	2	2	3
015	Juniper 3	221.33	101	52	1	2	5	3	6
016	Juniper 4	294.08	134	69	1	2	6	4	8
017	Sweetwater 1	106.28	48	25	0	1	2	1	3
018	Turkey	58.27	27	14	0	0	1	1	2
019	Juniper 5	118.19	54	28	1	1	3	2	3
020	Juniper 6	195.09	97	50	2	1	4	4	No Info
021	Sweetwater 2	22.01	10	5	0	0	1	0	1
022	Sweetwater 3	94.07	43	22	0	1	2	1	3
023	Reedy	73.25	43	21	1	0	1	3	No Info
024	Sweetwater 4	145.19	619	45	3	0	2	6	No Info
TOTAL		1600.37	1300	395	9	10	32	30	33

[a] Numbers for beef cows, milk cows and sheep were not available in the Census of Agriculture for Escambia County, AL, for 1997. Counts used to calculate livestock in subwatershed portions within Escambia County represent 1992 data.

[b] Numbers for beef cows and milk cows were not available in the Census of Agriculture for Santa Rosa County, FL, for 1997 or 1992. Counts used to calculate livestock in subwatershed portions within Santa Rosa County represent 1987 data.

Blackwater River

Table 4-4 presents the livestock counts for each subwatershed within the Blackwater River watershed.

Table 4-4. Livestock counts for subwatersheds within the Blackwater River watershed

ID	Subwatershed	Pasture (acres)	Cattle/ calves	Beef Cows[a, b]	Milk Cows[a, b]	Sheep/ Lambs[a]	Horses	Hogs	Chickens
007	Blackwater 1	294.70	96	51	0	0	6	12	6
008	Bull Pen	44.52	14	8	0	0	1	2	1
009	Blackwater 2	0.00	0	0	0	0	0	0	0
010	Blackwater 3	45.84	15	8	0	0	1	2	1
011	Rock Creek	306.05	157	80	4	0	5	14	2
012	Blackwater 4	0.00	0	0	0	0	0	0	0
013	Blackwater 5	13.15	4	2	0	0	0	1	0
014	Oak Creek	172.61	56	30	0	0	3	7	3
015	Blackwater 6	208.21	122	62	3	0	3	10	1
016	Boggy Hollow	582.79	254	132	2	1	9	21	7
017	Blackwater 7	145.44	93	47	3	0	2	7	0
018	A*	1266.27	750	384	11	4	11	34	0
019	Blackwater 8	144.33	93	46	3	0	2	7	0
020	Panther Creek	974.50	577	295	9	3	8	26	0
021	Blackwater 9	179.02	106	54	2	1	2	5	0
TOTAL		4551.44	2393	1229	37	9	56	156	24

[a] Numbers for beef cows, milk cows and sheep were not available in the Census of Agriculture for Escambia County, AL, for 1997. Counts used to calculate livestock in subwatershed portions within Escambia County represent 1992 data.

[b] Numbers for beef cows and milk cows were not available in the Census of Agriculture for Santa Rosa County, FL, for 1997 or 1992. Counts used to calculate livestock in subwatershed portions within Santa Rosa County represent 1987 data.

4.2.2 Failing Septic Systems

Onsite septic systems have the potential to deliver bacteria loads to surface waters due to system failure and malfunction. NSFC (1993) provided estimates of failing septic systems for each county within the Blackwater River watershed. The number of failing systems in each subwatershed was then estimated based on county area and area of subwatershed within each county. Without knowing the spatial distribution of septic systems, functioning or failing, it was assumed that failing systems are distributed evenly throughout their corresponding counties. A density of failing septic systems (number per acre) was determined for each

county by dividing the number of failing systems by the county area. The densities were then applied to the area of the subwatershed in each respective county to determine the number of failing systems in the area where the subwatershed and county intersect. These county/subwatershed estimates were summed to determine the total number of failing septic systems in the subwatersheds. The septic failure rates for Santa Rosa, Okaloosa, Escambia, and Covington counties are 0.01 percent, 0.02 percent, 0.00 percent, and 0.00 percent, respectively.

The following sections present the estimates of the number of failing septic systems in the subwatersheds within each listed watershed.

Big Coldwater Creek (including West Fork, East Fork, and Manning Creek)

Table 4-5 presents the number of failing septic systems for each subwatershed within the Big Coldwater Creek watershed.

Table 4-5. Inventory of failing septic systems in the subwatersheds of the Big Coldwater Creek watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
015	Coldwater 1	7865.84	4
016	Coldwater 2	13647.71	0
017	Earnest Mill	4098.04	2
018	West Fork 1	1533.05	1
019	East Fork 1	3215.92	1
020	West Fork 2	8109.30	4
021	Manning	7781.06	4
022	Wolf	3667.71	2
023	East Fork 2	3875.65	2
024	West Fork 3	207.33	0
025	Juniper	11661.64	5
026	West Fork 4	10743.86	5
027	Cobb	6193.75	0
028	West Fork 5	4623.62	2
029	West Fork 6	6026.06	3
030	West Fork 7	6595.03	3
031	East Fork 3	9888.00	5
032	Dixon 1	9761.03	4

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
033	East Fork 4	7197.22	3
034	Dixon 2	10382.87	4
035	Yellow Water	5826.04	3
036	East Fork 5	5753.35	1
TOTAL		152616.27	60

Big Juniper Creek

Table 4-6 presents the number of failing septic systems for each subwatershed within the Big Juniper Creek watershed.

Table 4-6. Inventory of failing septic systems in the subwatersheds of the Big Juniper Creek watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
012	Juniper 1	2227.12	1
013	Juniper 2	7107.88	3
014	Alligator	7662.61	0
015	Juniper 3	8684.56	0
016	Juniper 4	7535.91	4
017	Sweetwater 1	7384.04	3
018	Turkey	4765.75	2
019	Juniper 5	6321.54	0
020	Juniper 6	9098.70	4
021	Sweetwater 2	5908.52	3
022	Sweetwater 3	11605.21	5
023	Reedy	4400.57	2
024	Sweetwater 4	8337.16	4
TOTAL		91039.57	31

Blackwater River

Table 4-7 presents the number of failing septic systems for each subwatershed within the Blackwater River watershed.

Table 4-7. Inventory of failing septic systems in the subwatersheds of the Blackwater River watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
007	Blackwater 1	4884.85	2
008	Bull Pen	4156.47	1
009	Blackwater 2	1604.24	1
010	Blackwater 3	6368.76	2
011	Rock Creek	13454.53	2
012	Blackwater 4	895.89	0
013	Blackwater 5	761.02	0
014	Oak Creek	2775.71	1
015	Blackwater 6	5953.91	1
016	Boggy Hollow	9326.57	1
017	Blackwater 7	798.37	0
018	A*	19977.91	1
019	Blackwater 8	8473.61	0
020	Panther Creek	15856.19	0
021	Blackwater 9	8600.37	0
TOTAL		108486.4	14

The fecal coliform loading rates from failing septic systems used in developing TMDLs for the Blackwater River watershed are presented in Table C-1 in Appendix C.

4.2.3 Wildlife

Wildlife is another potential source of fecal coliform loading to receiving waterbodies. It is assumed that deer habitat within the watershed includes Forest/Vegetated, Cropland, Wetlands, Open Land, and Pastureland uses. Estimates for distributions of deer were provided by the Florida Fish and Wildlife Conservation Commission (personal communication, August 27, 1999). Three different densities (deer per square mile) were available for the watershed, representing different management areas. Estimates are determined based on “track estimates” where the ground is cleared, and then animal tracks are counted to estimate populations within an area. The provided densities were applied to deer habitat areas within the

watershed to estimate population counts by subwatershed. The highest density (5.8 deer/mi^2) was applied to the Forest/Vegetated, Cropland, and Wetlands areas, and the lowest density (2.9 deer/mi^2) was applied to Open Land and Pasture areas. The following sections present the inventories of deer in each subwatershed by land use considered deer habitat.

Big Coldwater Creek (including West Fork, East Fork, and Manning Creek)

Table 4-8 presents the wildlife counts by land use for each subwatershed within the Big Coldwater Creek watershed.

Table 4-8. Wildlife counts for each subwatershed within the Big Coldwater Creek watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
015	Coldwater 1	4	43	0	1	12	60
016	Coldwater 2	15	90	1	2	10	118
017	Earnest Mill	3	31	0	0	1	35
018	West Fork 1	5	5	0	1	1	12
019	East Fork 1	4	17	0	1	6	28
020	West Fork 2	31	21	0	5	9	66
021	Manning	19	33	0	3	8	63
022	Wolf	4	25	0	1	3	33
023	East Fork 2	1	30	0	0	3	34
024	West Fork 3	0	1	0	0	0	1
025	Juniper	25	61	0	4	7	97
026	West Fork 4	19	59	0	3	10	91
027	Cobb	19	24	0	3	5	51
030	West Fork 5	14	16	0	2	6	38
031	West Fork 6	18	26	0	3	4	51
032	West Fork 7	12	37	0	2	6	57
033	East Fork 3	3	70	0	0	15	88
034	Dixon 1	3	67	0	0	16	86
035	East Fork 4	0	48	0	0	16	64
036	Dixon 2	5	75	0	1	11	92
037	Yellow Water	2	46	0	0	4	52
038	East Fork 5	4	41	0	1	4	50
TOTAL		220	885	1	35	159	1300

Big Juniper Creek

Table 4-9 presents the wildlife counts by land use for each subwatershed within the Big Juniper Creek watershed.

Table 4-9. Wildlife counts for each subwatershed within the Big Juniper Creek watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
012	Juniper 1	1	15	0	0	3	19
013	Juniper 2	1	57	0	1	4	63
014	Alligator	1	58	0	1	8	68
015	Juniper 3	3	67	0	1	7	78
016	Juniper 4	3	51	0	1	11	66
017	Sweetwater 1	1	50	0	0	14	65
018	Turkey	1	35	0	0	7	43
019	Juniper 5	1	45	0	1	9	56
020	Juniper 6	6	64	0	1	11	82
021	Sweetwater 2	0	43	0	0	8	51
022	Sweetwater 3	1	84	0	0	19	104
023	Reedy	1	32	0	0	6	39
024	Sweetwater 4	2	64	0	1	6	73
TOTAL		22	665	0	7	113	807

Blackwater River

Table 4-10 presents the wildlife counts by land use for each subwatershed within the Blackwater River watershed.

Table 4-10. Wildlife counts for each subwatershed within the Blackwater River watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
007	Blackwater 1	3	30	0	1	7	41
008	Bull Pen	1	31	0	0	6	38
009	Blackwater 2	0	12	0	0	2	14
010	Blackwater 3	1	49	0	0	5	55
011	Rock Creek	3	109	0	1	6	119
012	Blackwater 4	0	7	3	0	2	12

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
013	Blackwater 5	0	6	0	0	1	7
014	Oak Creek	2	18	0	1	3	24
015	Blackwater 6	4	44	0	1	4	53
016	Boggy Hollow	6	64	0	3	2	75
017	Blackwater 7	1	5	0	1	0	7
018	A*	8	156	0	6	1	171
019	Blackwater 8	1	71	0	1	0	73
020	Panther Creek	9	116	0	4	2	131
021	Blackwater 9	4	69	0	1	0	74
TOTAL		45	820	3	21	46	935

4.2.4. Cattle in the Stream

When cattle are not excluded from stream reaches, they represent a potential source of fecal coliform loading directly to the stream. To account for the potential influence of cattle loads deposited directly in stream reaches within the watersheds, fecal coliform loads from cattle in streams were calculated and characterized as a direct source of loading to the stream segments. To determine the number of cows in the stream at any time, it was assumed that 10 percent of the cows in the watershed have access to streams; that 7 percent of those cows are in or around the stream at any given time; and that 5 percent of those cows in the stream are actually depositing manure in the stream reach at any given time. The fecal coliform loading rates from cattle in the stream used in developing TMDLs for the Blackwater River watershed are presented in Table C-2 in Appendix C.

4.2.5 Critical Conditions

Nonpoint source loading is typically precipitation-driven. In-stream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods, little or no land-based runoff occurs, and elevated in-stream bacteria levels may be due to point sources (Novotny and Olem, 1994). Because the majority of available water quality monitoring data for the Blackwater River watershed do not have corresponding flow measurements, it is difficult to evaluate critical flow conditions. Without corresponding flow values, it is impossible to determine whether elevated bacteria levels occur during base flow, indicating pollution from point sources and failing septic systems, or during high-flow events, indicating pollution from nonpoint sources.

In the Blackwater River watershed, USGS flow gage 02370000 and FDEP water quality station 33030001 are located at the same site. Plotting the continuous flow from 02370000 and plotting the single samples from 33030001 on their measurement dates suggests that flow and coliform concentrations follow the same relative pattern, with higher coliform levels corresponding to higher flow values. However, this is a crude comparison using the best available data.

During calibration and establishment of existing conditions in the model, the model was run for a 5-year period (1990-1995) representing a time period of varying hydrologic and climatic conditions. However, model output for 1994 was used for evaluation of allocation scenarios because modeled water quality during 1994 represented the worst conditions during the 5-year period, with the highest concentrations in magnitude. Allocations are determined on a 30-day basis for 1994 to meet the geometric mean standard of 200 counts/100 mL.

5. LINKAGE OF SOURCES AND WATER QUALITY RESPONSE

5.1 SELECTED WATERSHEDS

Seven segments on the main stem of or tributaries to the Blackwater River are listed on Florida's 1998 303(d) list as impaired by coliform and are considered for TMDL development in this study. Some of the TMDLs can be developed using a nested watershed approach, where an impaired segment has tributaries that are impaired as well. This section presents the technical approach used for coliform TMDL development for the following seven impaired waters within the Blackwater River watershed:

- Blackwater River
- Big Juniper Creek
- Big Coldwater Creek, including the listed tributaries (West Fork Big Coldwater Creek, East Fork Big Coldwater Creek, and Manning Creek)

5.2 TMDL ENDPOINT

Because the Blackwater River and its tributaries have associated numeric criteria in their water quality standards for fecal coliform, those applicable numeric criteria would represent the in-stream water quality target for TMDL development. The coliform TMDLs developed for the impaired segments in the Blackwater River watershed will establish wasteload and load allocations that would allow for the attainment of the coliform bacteria water quality standard of a monthly average of 200 counts/100 mL, expressed as a geometric mean based on a minimum of 10 samples taken over a 30-day period. The model output provides continuous daily concentrations to compare to the water quality standards.

5.3 LINKAGE OF SOURCES AND TMDL ENDPOINT

Establishing the relationship between the in-stream water quality target and the source loadings is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that indicate a waterbody's response to flow and loading conditions. The following sections provide discussion of the modeling tools and model setup and application.

5.3.1 Modeling Framework

The U.S. EPA Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system Version 2.0 (USEPA, 1998a) and the Nonpoint Source Model (NPSM) are used to predict the significance of coliform sources and levels in the Blackwater River watershed. BASINS is a multipurpose environmental analysis system for use in performing watershed and water quality-based studies. A geographic information system (GIS) provides the integrating framework for BASINS and allows for the display and analysis of a wide variety of landscape information (e.g., land uses, monitoring stations, point source dischargers). The NPSM simulates nonpoint source runoff from selected watersheds, as well as the transport and flow of the pollutants through stream reaches. BASINS produces time series data, allowing for sufficient data to compare to the water quality target in the analysis.

5.3.2 Model Setup

The watersheds of the 303(d)-listed segments were divided into subwatersheds to spatially evaluate pollutant sources and loading and to more accurately represent the stream systems. Stream network segmentation and subwatershed delineation for this study were preliminarily based on GIS data layers of delineated subwatersheds provided by FDEP. Each listed watershed was evaluated, and subwatersheds were finalized based on the Florida subwatersheds, topography, location of monitoring stations, and distribution of land use. (Figures 3-2 through 3-4 present the subwatersheds for each of the 303(d)-listed segments.)

Using the subwatershed delineations, reach networks within the model were established for the listed watersheds with corresponding reach characteristics (e.g., width, depth, length, slope, elevations). For subwatersheds based on RF1 reach segments, reach characteristics were pulled directly from RF1 attribute tables. Reach characteristics for RF3 reaches were estimated based on RF1 information as described below.

After the subwatersheds were delineated, reach networks within the model were established. For subwatersheds based on RF1 reach segments, reach characteristics (e.g., width, depth, length, slope, elevations) were accessed from the RF1 database. Reach characteristics for RF3 reaches were estimated based on reach network, elevation and topography coverages. Stream cross-section dimensions, including width and depth, were developed using regional curves that relate watershed size to stream cross section (Rosgen, 1996). The functions used to estimate the stream depth and width of the RF3 reaches are:

$$d = 1.4995 * A^{0.2838}$$

where d is the stream depth in feet and A is the upstream watershed area in square miles, and

$$w = 14.49 * A^{0.40}$$

where w is the stream width in feet and A is the upstream watershed area in square miles. Some reach characteristics were adjusted to result in appropriate flow output and model response.

5.3.3 Hydrologic Calibration

To represent the hydrologic conditions of the Blackwater River watersheds, the model was calibrated to the best available flow, climate, and stream data. The following sections describe the information and process used in calibrating the hydrology of the model.

Data and Model Setup

BASINS data and USGS databases were queried to identify flow gaging stations within the Blackwater River watershed, as well as the surrounding cataloging units (Yellow, Pea, and Choctawhatchee). The gages were evaluated for type and amount of flow data. Many of the gages within or around the watersheds recorded only peak flow data or do not have continuous flow data for from 1980 to 1998. USGS station 02370000 is located on the main stem Blackwater River, just downstream of the listed segment. Continuous flow data are available for this station from January 1, 1970 to November 17, 1992. For these reasons, USGS gage 02370000 was used to calibrate the hydrology of the models for the watersheds of the listed segments in the Blackwater River watershed.

The model was set up with a stream network representing the RF1 reaches upstream of USGS station 02370000, as shown in Figure 5-1. Stream parameters such as segment length, width, depth, slope, and elevations were available in RF1 attribute tables and were used to characterize the reach network in NPSM.

Representative Weather Data and Modeling Period

The model was run for a representative time period chosen primarily for the availability and relevance of data. The water year used for calibration is October 1, 1978 to September 30, 1979. Because climate data drive the hydrological modules of the model, appropriate weather data are necessary to represent the hydrologic conditions within the calibration watershed. Data from weather stations within and in proximity to the watersheds were evaluated for use in the model. Two stations (7962 and 765), both at Blackman, Florida, are located within the Blackwater River watershed within close proximity to USGS gage 02370000. However, data for the stations were not collected after 1969 at one and 1986 at the other. Data from surrounding stations were evaluated, considering period of record, location relative to gage, and quality of data (e.g., continuity and gaps in data). Because many of the area weather stations did not collect data within

the period of record of available flow data, they were not considered for use in the model calibration. Because local weather can vary significantly in coastal areas, climate data from the stations outside the watershed could potentially provide a hydrologic simulation that is not comparable to, or representative of, the existing watershed flow data.

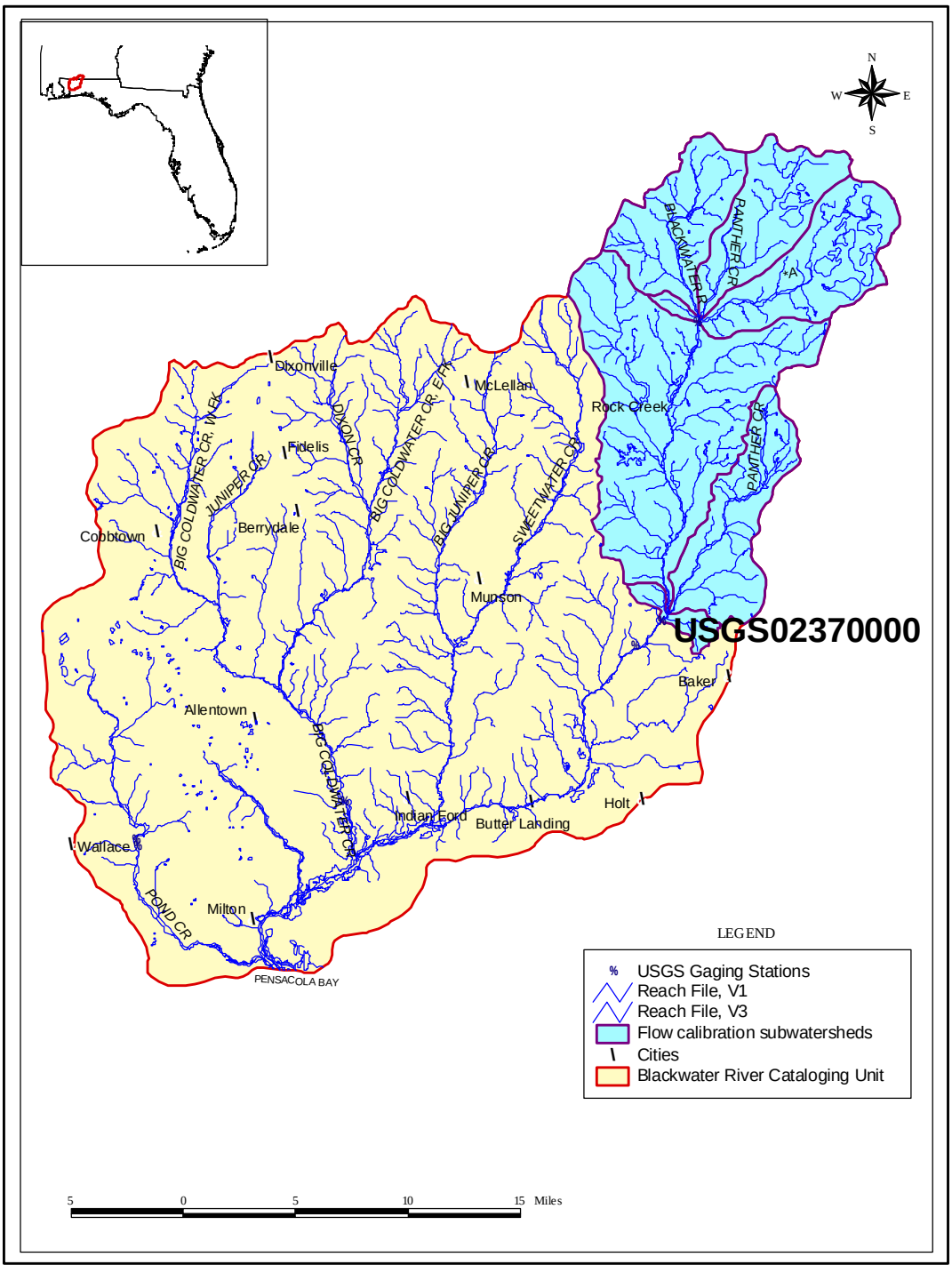

Figure 5-1. Watershed used in hydrologic calibration at USGS gage 02370000

The model was run using data from various weather stations in and around the watershed to evaluate the differences in data and the resulting effects on model flow output. The analysis indicated that data from surrounding stations did not provide as representative a hydrologic simulation as earlier weather data from within the watershed. Precipitation records and Palmer Drought Severity Indices were examined to identify years that were not extremely wet or dry, but rather presented varying climatic and hydrologic conditions. The calibration was performed for the 1979 water year because 1979 was a climatically varying year and occurred during the period of record of available weather data from Station 765 at Blackman within the Blackwater River watershed.

To represent the weather throughout the watershed, Blackman weather station in FL was used in the model. The hourly precipitation data for this station contained various intervals of accumulated, missing, or deleted data. Accumulated data represent cumulative precipitation over several hours, but the exact hourly distribution of the data is unknown. Accumulated, missing, and deleted data records were repaired based on hourly rainfall patterns at nearby stations with unimpaired data. These intervals were patched using the *normal-ratio method*, which estimates a missing rainfall record with a weighted average from surrounding stations with similar rainfall patterns according to the relationship

$$P_A = \frac{1}{n} \left(\sum_{i=1}^{n} \frac{N_A}{N_i} P_i \right)$$

where P_A is the impaired precipitation value at station A, n is the number of surrounding stations with unimpaired data at the same specific point in time, N_A is the long-term average precipitation at station A, N_i is the long-term average precipitation at nearby station i, and P_i is the observed precipitation at nearby station i. For each impaired data record at station A, n consists of only the surrounding stations with unimpaired data; therefore, for each record, n varies from 1 to the maximum number of surrounding stations. When no precipitation is available at the surrounding stations, zero precipitation is assumed at station A. The US Weather Bureau has a long-established practice of using the long-term average rainfall as the precipitation normal. This method is adaptable to regions where there is large orographic variation in precipitation.

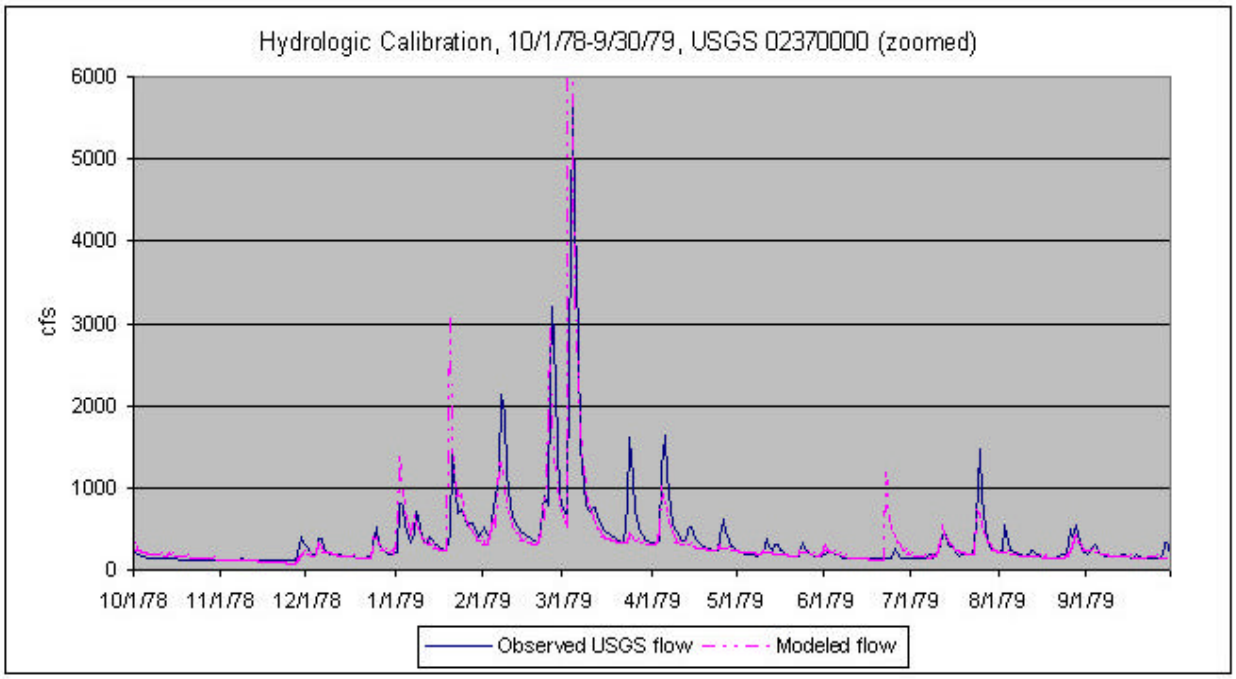

Figure 5-2. Observed and simulated flows at USGS gage 02370000, Blackwater River near Baker, Florida

5.3.4 Source Representation

The nonpoint sources within the Blackwater watersheds are represented differently in the model depending on their type and behavior. The following nonpoint sources have been identified within the listed watersheds:

- General land-based runoff
- Grazing livestock
- Wildlife
- Failing septic systems
- Cattle in the stream reaches

Table 5-1. Results of data comparison of simulated and observed flows (in cfs) within the calibration watershed.

Calculation	Simulated	Observed	Error	Recommended Error [a]
Total flow volume	62.84	61.69	1.83 %	10 %
Total of lowest 50% of flows	12.71	12.17	4.24 %	10 %
Total of highest 10% of flows	28.61	24.91	12.93 %	15 %
Summer flow volume	10.75	11.39	-5.93 %	30 %
Fall flow volume	8.66	9.81	-13.34 %	30 %
Winter flow volume	6.50	6.63	-2.10 %	30 %
Spring flow volume	36.94	33.86	8.34 %	30 %
Total storm volume	49.53	41.78	15.64 %	20 %
Summer storm volume	7.51	6.40	14.87 %	50 %

[a] Recommended error suggested in Lumb et al. (1994).

Typically, nonpoint sources are characterized by buildup and washoff processes: they contribute bacteria to the land surface, where they accumulate and are available for runoff during storm events. These nonpoint sources can be represented in the model as land-based runoff from the land use categories to account for their contribution to coliform loading within the watersheds. Coliform accumulation rates (number per acre per day) can be calculated for each land use based on all sources contributing coliform to the surface of the land use. For this study, where specific sources were identified as contributing to a land use, accumulation rates were calculated. For example, grazing livestock and wildlife are specific sources contributing to land uses within the watershed. The land uses that experience bacteria accumulation due to livestock and wildlife include

- Cropland (wildlife)
- Forest/Vegetated (wildlife)
- Open Land (wildlife)
- Pasture (livestock and wildlife)
- Wetlands (wildlife)

Accumulation rates were specifically calculated for these land uses based on the distribution of animals by land use for each subwatershed (see Section 4. Source Assessment) and using typical fecal coliform production rates for different animal types (Table 5-2). For example, the coliform accumulation rate for pasturelands is the sum of the individual coliform accumulation rates due to contributions from grazing livestock (including milk and beef cattle, sheep, and horses) and wildlife.

Table 5-2. Fecal coliform production rates for various animals

Animal	Fecal Coliform Production Rate	Reference
Milk cow	7.1×10^{10} counts/day	ASAE, 1998
Beef cow	6.98×10^{10} counts/day	ASAE, 1998
Sheep	1.8×10^{10} counts/day	Metcalf & Eddy, 1991
Hog	8.9×10^{9} counts/day	Metcalf & Eddy, 1991
Deer	5×10^{8} counts/day	Linear interpolation; Metcalf & Eddy, 1991

Other land use types did not specify sources identified as contributing fecal coliform to their surface. Literature values for typical fecal coliform accumulation rates were used for those land uses—Urban, Residential, and Other. The literature value used for residential land uses is 1.43 E+07 #/ac/day, the average of the default values for low- and high-density residential areas (Horner, 1992). The literature value used for urban land uses is the median default value of 6.19 E+06 #/ac/day for commercial land (Horner, 1992). It is assumed that the "other" land use is half the load from low-density residential, therefore, the value used to represent fecal coliform accumulation rates on other land is 5.14 E+06 #/ac/day.

Failing septic systems represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface or subsurface malfunctions. The estimation of number of failing septic systems is discussed in Section 4.2.2. To provide for a margin of safety accounting for the uncertainty of the number, location, and behavior (e.g., surface vs. subsurface breakouts; proximity to stream) of the failing systems, failing septic systems are represented in the model as direct sources of fecal coliform to the stream reaches. Fecal coliform contributions from failing septic system discharges are included in the model with a representative flow and concentration, which were quantified based on the following information:

- Number of failing septic systems in each subwatershed (as discussed in Section 4.2.2).

- Estimated population served by the septic systems (average of county averages of people per household, obtained from 1990 Bureau of the Census data).
- An average daily discharge of 70 gallons/person/day (Horsley & Witten, 1996).
- Septic effluent concentration of 10^4 cfu/100 mL (Horsley & Witten, 1996).

The septic system contribution in the model inherently contains a margin of safety based on the assumption that all the fecal coliform bacteria discharged from failing septic systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after being filtered through the soil or after die-off during transport.

Cattle depositing manure directly into stream reaches also represent a direct nonpoint source of fecal coliform. The number of cattle producing and depositing fecal coliform in watershed streams at any give time were estimated, as discussed in Section 4.2.4. The cattle were then simulated in the model as direct sources of fecal coliform loads, with a representative flow rate (cubic feet per second) and load (counts per hour). The representative load was calculated based on the number of cows in the stream and the fecal coliform production rate for cows (Table 5-2). The flow was estimated based on the number of cows in the stream, the manure production rate of cows (ASAE, 1998) and the approximate density of cow manure.

5.3.5 Water Quality Calibration

After the hydrological calibration was completed and sources were most appropriately characterized and represented in the model, the modeled in-stream fecal coliform concentrations were compared to available observed data. Parameters representing such processes as bacteria accumulation, surface washoff, and interflow and groundwater concentrations were adjusted to calibrate modeled water quality to the observed ambient water quality data. Modeled water quality was compared to existing data at five stations within the three main watersheds. The stations were chosen for calibration because they had data available during the modeling time period (1991-1995) and had some mix of baseflow and peak concentrations. The stations are presented in Figure 5-3.

In some cases, there was some uncertainty concerning the temporal comparison of modeled concentration peaks and observed peaks. The observed water quality represents an ambient concentration from a grab sample and the modeled water quality represents daily average concentrations. If there is a storm event during the sampling day, the grab sample may reflect a concentration on the rising or falling curve of the

pollutograph or the peak storm concentration. To confirm calibration of the model's water quality and to avoid overestimation of the concentration peaks, daily output from the model was compared to the observed ambient data. Figure 5-4 presents calibrated daily modeled fecal coliform concentrations and observed fecal coliform concentrations for 1995.

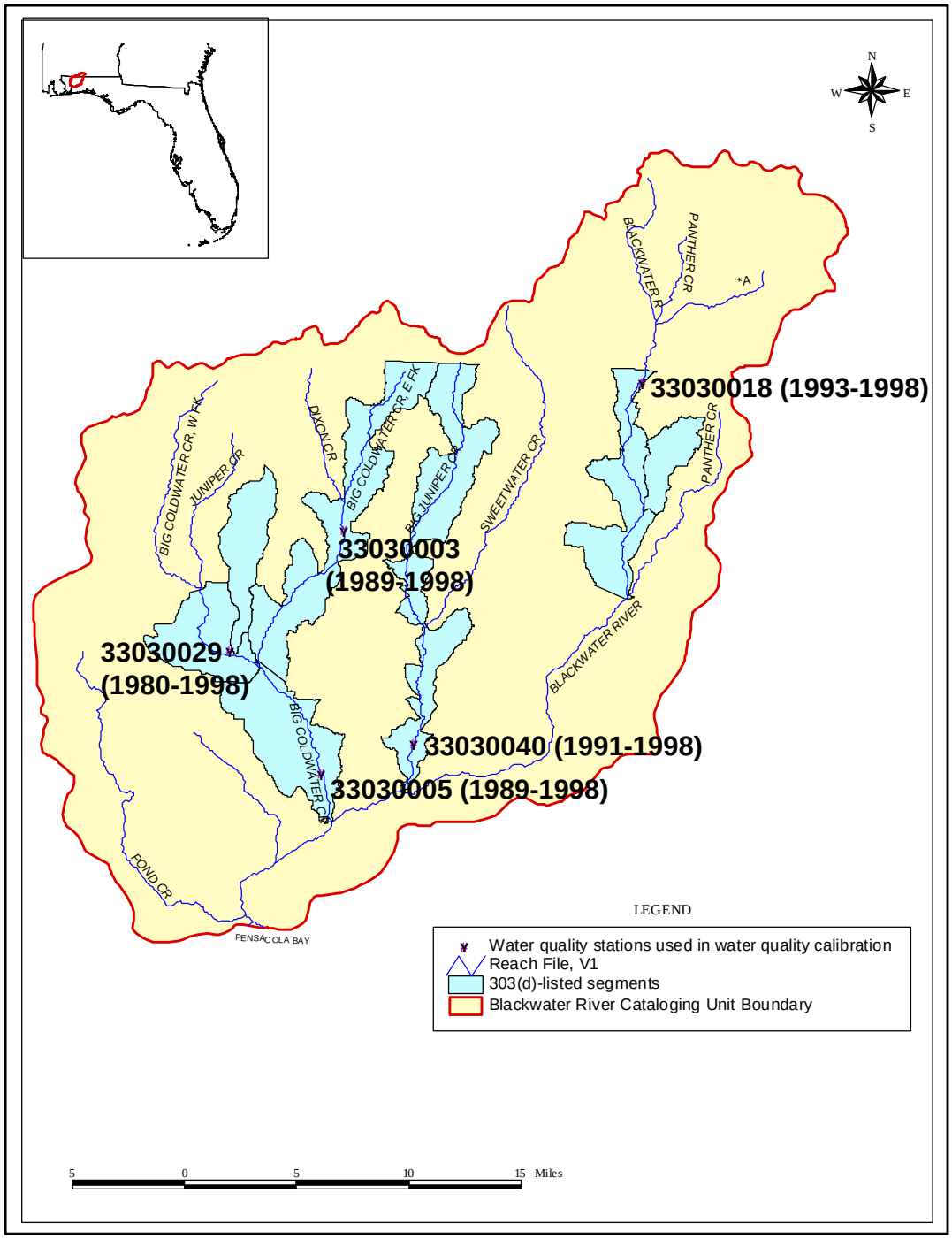

Figure 5-3. Monitoring stations used in water quality calibration

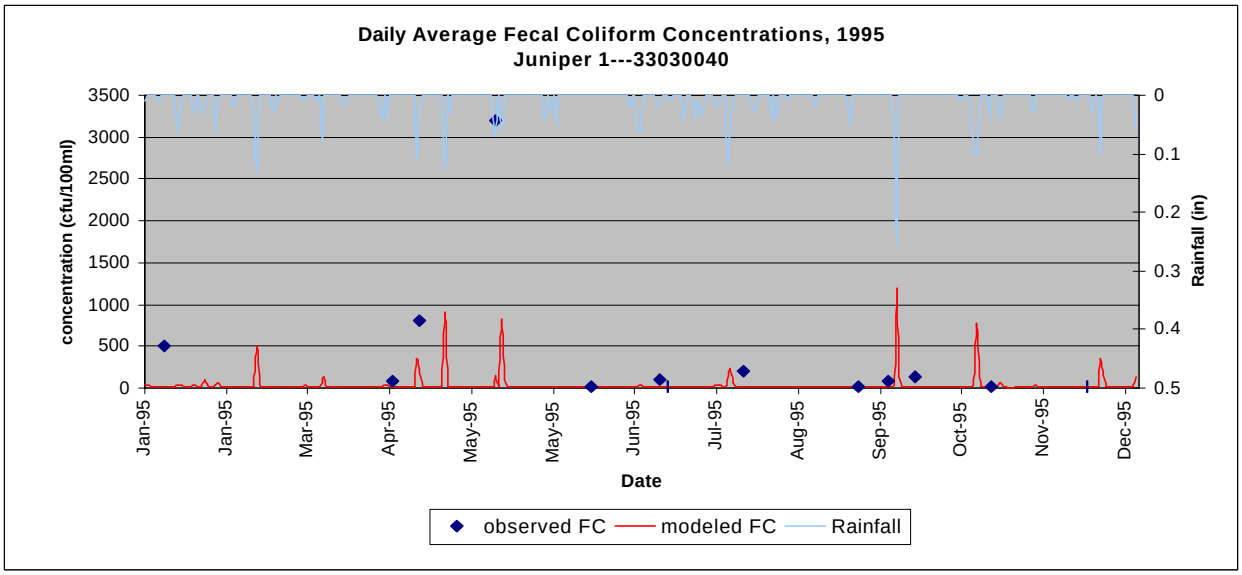

Figure 5-4. Daily modeled fecal coliform concentration in Juniper 1 and observed fecal coliform concentrations at Station 33030040

5.3.6 Source Sensitivity Analysis

An important step in the TMDL process is to evaluate the relative significance of the various source loading estimates on the in-stream conditions. In the Blackwater River watershed, potential sources of fecal coliform include runoff from pastures with grazing animals; failing septic systems; cattle in the stream reaches; and wildlife contributions. Sensitivity analysis was conducted to evaluate the sensitivity of the receiving water quality to the loadings from each of these sources. Sensitivity analyses provide insight into the relative magnitude and effects of the individual source loadings on the instream water quality.

Following the source identification and characterization and analysis of water quality data, several scenarios were developed to test the sensitivity of the stream to each source. To perform the sensitivity analysis, the model was run using existing conditions as a base, and the loads from individual sources (e.g., pasture runoff, failing septic systems) were eliminated while all other parameters remain unchanged. This modeling was performed for each source to determine the impact of individual source loadings on water quality and the impact of sources relative to one another. The analyses investigated the effect of direct sources vs. nonpoint sources as well as the relative effect of each of the nonpoint sources (i.e., failing septic systems vs. pasture runoff, pasture runoff vs. urban runoff). The source sensitivity analysis identified the most sensitive (or influential) sources for the development of pollutant allocations that result in the attainment of water quality standards.

The following individual scenarios were evaluated for the Blackwater River watersheds:

1. Existing conditions
2. Existing conditions minus loading from Pasture land
3. Existing conditions minus loading from Forest/Vegetated land
4. Existing conditions minus loading from Urban and Residential land
5. Existing conditions minus contributions from failing septic systems
6. Existing conditions minus contributions from cattle in the stream

Instream concentrations were evaluated for each scenario, relative to one another and to existing conditions. Table 5-3 presents a statistical summary for each scenario for the Juniper 1 subwatershed in the Big Juniper Creek watershed for 1995. The elimination of surface loads of fecal coliform from any land use except Pasture has a minimal impact on the in-stream concentrations. Failing septic systems (and cattle in the

stream) are characterized as constant sources discharging fecal coliform directly to the stream reaches. Because of this, removing the contribution from failing septic systems (and cattle in the stream, to an extent) lowers the baseline concentrations during low flows but has little effect on the concentration peaks during higher flows.

Table 5-3. Summaries of in-stream fecal coliform concentrations (counts/100 mL) under six scenarios, Juniper 1, 1995

Scenario [a]	Minimum	Median	Maximum	Average
1	9.67	14.03	1192.00	35.72
2	9.51	12.80	26.85	13.73
3	9.51	13.80	1189.20	35.45
4	9.51	13.80	1191.90	35.50
5	0.23	2.39	1185.60	25.01
6	9.35	13.54	1191.80	35.29

[a] Scenario 1—Existing conditions
Scenario 2—Existing conditions minus loading from Pasture land
Scenario 3—Existing conditions minus loading from Forest/Vegetated land
Scenario 4—Existing conditions minus loading from Urban and Residential land
Scenario 5—Existing conditions minus contributions from failing septic systems
Scenario 6—Existing conditions minus contributions from cattle in the stream

6. TMDLs

This section presents the TMDLs developed for fecal coliform for six reaches within the Blackwater River watershed—Big Coldwater Creek, Big Juniper Creek, Blackwater River, East Fork Big Coldwater Creek, Manning Creek, and West Fork Big Coldwater Creek. All TMDLs were allocated on a 30-day basis. Model output for 1994 was used to determine the TMDL and allocations because modeled water quality during 1994 represented recent critical conditions during the modeling period. Allocations were determined on a 30-day basis for 1994 and represented compliance with the 200 counts/100 mL as a geometric mean standard (actually 190 counts/100 mL when considering the margin of safety).

6.1 BIG COLDWATER CREEK WATERSHED

In addition to the listed segment of its main stem, the Big Coldwater Creek watershed includes the watersheds of three other listed segments—East Fork Big Coldwater Creek, Manning Creek and West Fork Big Coldwater Creek. The TMDLs for these four listed segments are presented in the following subsections.

6.1.1 Big Coldwater Creek

The overall 30-day TMDL allocations for Big Coldwater Creek are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	1.83 E+11	1.83 E+11
Forest/Vegetated	7.30 E+11	7.30 E+11
Open Land	2.48 E+09	2.48 E+09
Other	3.31 E+09	3.31 E+09
Pasture	7.23 E+13	7.23 E+13
Residential	6.27 E+10	6.27 E+10
Urban	4.96 E+10	4.96 E+10
Wetlands	1.38 E+11	1.38 E+11
Failing Septic Systems	1.25 E+11	1.25 E+11
Cattle in the Stream	4.39 E+12	4.39 E+12

Total Existing Load	**7.80 E+13**	**Load Allocation**	**7.80 E+13**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**5.12 E+12**
		Reserve for Future Growth/Activities	**1.93 E+13**
		TMDL = Loading Capacity =	**1.02 E+14**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.1.2 East Fork Big Coldwater Creek

The overall 30-day TMDL allocations for East Fork Big Coldwater Creek are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	2.31 E+10	2.31 E+10
Forest/Vegetated	3.38 E+11	3.38 E+11
Open Land	1.86 E+08	1.86 E+08
Other	1.43 E+09	1.43 E+09
Pasture	7.13 E+12	7.13 E+12
Residential	4.74 E+09	4.74 E+09
Urban	4.71 E+09	4.71 E+09
Wetlands	6.58 E+10	6.58 E+10
Failing Septic Systems	5.31 E+10	5.31 E+10
Cattle in the Stream	6.34 E+11	6.34 E+11

Total Existing Load	**8.25 E+12**	**Total Load Allocation**	**8.25 E+12**
		Wasteload Allocation	**0**
		Margin of Safety [1]	**8.26 E+11**
		Reserve for Future Growth/Activities	**7.48 E+12**
		TMDL = Loading Capacity =	**1.65 E+13**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.1.3 Manning Creek

The overall 30-day TMDL allocations for Manning Creek are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	1.57 E+10	1.57 E+10
Forest/Vegetated	2.69 E+10	2.69 E+10
Open Land	0.00 E+00	0.00 E+00
Other	1.98 E+07	1.98 E+07
Pasture	5.98 E+12	5.98 E+12
Residential	9.42 E+09	9.42 E+09
Urban	2.88 E+09	2.88 E+09
Wetlands	6.70 E+09	6.70 E+09
Failing Septic Systems	7.58 E+09	7.58 E+09
Cattle in the Stream	3.45 E+11	3.45 E+11

Total Existing Load	**6.38 E+12**	**Total Load Allocation**	**6.38 E+12**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**3.68 E+11**
		Reserve for Future Growth/Activities	**6.22 E+11**
		TMDL = Loading Capacity =	**7.36 E+12**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.1.4 West Fork Big Coldwater Creek

The overall 30-day TMDL allocations for West Fork Big Coldwater Creek are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	1.41 E+11	1.41 E+11
Forest/Vegetated	2.43 E+11	2.43 E+11
Open Land	7.88 E+08	7.88 E+08
Other	1.03 E+09	1.03 E+09
Pasture	5.66 E+13	5.66 E+13
Residential	5.12 E+10	5.12 E+10
Urban	1.48 E+10	1.48 E+10
Wetlands	4.77 E+10	4.77 E+10
Failing Septic Systems	6.01 E+10	6.01 E+10
Cattle in the Stream	3.29 E+12	3.29 E+12

Total Existing Load	**6.04 E+13**	**Total Load Allocation**	**6.04 E+13**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**3.42E+12**
		Reserve for Future Growth/Activities	**4.53 E+12**
		TMDL = Loading Capacity =	**6.83 E+13**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.2 BIG JUNIPER WATERSHED

The overall 30-day TMDL allocations for Big Juniper Creek are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	2.68 E+10	2.68 E+10
Forest/Vegetated	8.42 E+11	8.42 E+11
Open Land	1.45 E+08	1.45 E+08
Other	5.93 E+08	5.93 E+08
Pasture	2.58 E+13	2.58 E+13
Residential	9.83 E+09	9.83 E+09
Urban	9.42 E+09	9.42 E+09
Wetlands	1.50 E+11	1.50 E+11
Failing Septic Systems	6.53 E+10	6.53 E+10
Cattle in the Stream	1.27 E+12	1.27 E+12

Total Existing Load	**2.82 E+13**	**Total Load Allocation**	**2.82 E+13**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**2.05 E+12**
		Reserve for Future Growth/Activities	**1.07 E+13**
		TMDL = Loading Capacity =	**4.09 E+13**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.3 BLACKWATER WATERSHED

The overall 30-day TMDL allocations for the Blackwater River are presented in the following table.

Source	Existing Fecal Coliform Load (counts/30 days)	Allocated Fecal Coliform Load (counts/30 days)
Cropland	8.75 E+10	8.75 E+10
Forest/Vegetated	1.63 E+12	1.63 E+12
Open Land	6.39 E+07	6.39 E+07
Other	5.60 E+10	5.60 E+10
Pasture	1.88 E+13	1.88 E+13
Residential	8.58 E+09	8.58 E+09
Urban	1.69 E+09	1.69 E+09
Wetlands	8.92 E+10	8.92 E+10
Failing Septic Systems	2.92 E+10	2.92 E+10
Cattle in the Stream	2.72 E+12	2.72 E+12

Total Existing Load	**2.33 E+13**	**Total Load Allocation**	**2.33 E+13**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**1.80 E+12**
		Reserve for Future Growth/Activities	**1.14 E+13**
		TMDL = Loading Capacity =	**3.65 E+13**

[1]The MOS was included implicitly in the analysis with conservative assumptions. See Section 6.4.
[2]A Reserve fro Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.5.

6.4 MARGIN OF SAFETY

The margin of safety (MOS) is a required part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991):

- Implicitly incorporate the MOS using conservative assumptions to develop allocations or
- Explicitly specify a portion of the total TMDL as the MOS using the remainder for wasteload and load allocations.

The MOS was incorporated both implicitly and explicitly in developing the TMDLs. Assumption made in simulating failing septic system loads is an example of implicit conservative assumption use din the modeling prosess).

The simulation of load contribution from failing septic systems assumes that all fecal coliform bacteria discharged by the failing systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after filtration through soil or surface die-off. Additionally, these discharges from failing systems are assumed to be constant throughout the year, while failures may actually occur less frequently.

To provide an explicit margin of safety, the water quality target for the TMDL was established at a geometric mean of 190 counts/100 mL for a 30-day period, which is 5 percent lower than the water quality standard of 200 counts/100 mL.

6.5 RESERVE FOR FUTURE GROWTH/ACTIVITIES

If the watershed's existing load to the watershed was found to be below the target/endpoint, which was the geometric mean water quality standard less the explicit margin of safety (190 counts/100 mL), then a "reserve for future growth/activities" was calculated. The reserve for future growth/activities is the amount of fecal coliform loading that can be contributed to the watershed on top of the existing loading without exceeding the target concentration of 190 counts/100 mL. The reserve for future growth was calculated by increasing the fecal coliform contributions from the most significant source in the watershed until the concentrations reached the target/endpoint.

6.6 SEASONALITY

Seasonality was considered during the TMDL analysis through representatin of conditions thoughout an entire year. Seasonal differences in coliform levels could be caused by seasonal variations in precipitation and climate or by seasonal differences in activities in the watershed (e.g., land application of agricultural waste, recreational activities, etc.). Seasonality was evaluated using observed water quality and flow data. Water quality samples were collected quarterly at several monitoring stations in the watershed, providing coliform samples during different times of the year. These data do not suggest a distinct seasonal pattern of in-stream coliform levels, primarily becasue they do not provide consistent records of coliform levels during and across seasons and they do not have corresponding flow values. There is an apparent difference in flow volumes over seasons, indicating varying hydrologic as well as water quality conditions across seasons; although the seasonal differences do not consistently appear over the period of record for flow in the watershed. Although the modeling represented seasonal variation, the TMDLs were developed on an 30-day basis.

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Appendix A
Land Use Classification

Table A-1. Land use classifications in original land use coverages and their associated TMDL classification

Land Use Code	Description	TMDL Classification
	Florida classifications	
8110	Airports	Urban
2540	Aquaculture	Water
6110	Bay Swamps	Wetlands
7450	Burned Areas	Other
1480	Cemeteries	Open Land
1400	Commercial and Services	Urban
1860	Community Recreational Facilities	Urban
4410	Coniferous Plantations	Forest/Vegetated
1760	Correctional	Urban
2100	Cropland and Pastureland	Cropland/Pasture
6210	Cypress	Wetlands
7400	Disturbed Land	Other
1710	Educational facilities	Urban
8310	Electrical Power Facilities	Urban
8320	Electrical Power Transmission Lines	Urban
6440	Emergent Aquatic Vegetation	Wetlands
1600	Extractive	Other
2300	Feeding Operations	Pasture
4430	Forest Regeneration Areas	Forest/Vegetated
6410	Freshwater Marshes	Wetlands
1820	Golf Courses	Open Land
1660	Holding ponds	Other
1500	Industrial	Urban
6160	Inland Ponds and Sloughs	Water
6530	Intermittent Ponds	Water
1420	Junk Yards	Urban
5200	Lakes	Water
1740	Medical and Health Care	Urban

Land Use Code	Description	TMDL Classification
1730	Military	Urban
4340	Mixed Coniferous/Hardwood	Forest/Vegetated
1120	Mobile Home Units	Residential
1320	Mobile Home Units, High-Density	Residential
1220	Mobile Home Units, Medium-Density	Residential
2400	Nurseries and Vineyards	Forest/Vegetated
1640	Oil and Gas Fields	Urban
8170	Oil, Water, or Gas Transmission Lines	Other
1900	Open Land (Urban)	Open Land
2600	Other Open Lands (Rural)	Open Land
10	Outside Study Area	Other
1850	Parks and Zoos	Open Land
1800	Recreational	Urban
1720	Religious	Urban
5300	Reservoirs	Water
1300	Residential, High-Density	Residential
1100	Residential, Low-Density	Residential
1200	Residential, Medium-Density	Residential
7500	Riverine Sandbars	Other
8140	Roads and Highways	Urban
1620	Sand and Gravel Pits	Other
7200	Sand other than Beaches	Other
3200	Shrub and Brushland	Forest/Vegetated
5100	Streams and Waterways	Water
1610	Strip Mines	Other
1450	Tourist Services	Urban
8210	Transmissions Towers	Urban
8100	Transportation	Urban
2200	Tree Crops	Forest/Vegetated
4100	Upland Coniferous Forests	Forest/Vegetated
4200	Upland Hardwood Forests	Forest/Vegetated

Land Use Code	Description	TMDL Classification
6400	Vegetated Non-Forested Wetlands	Wetlands
6200	Wetland Coniferous Forests	Wetlands
6300	Wetland Forested Mixed	Wetlands
6100	Wetland Hardwood Forest	Wetlands
6900	Wetland Scrub Shrub	Wetlands
MRLC classification		
41	Deciduous Forest	Forest/Vegetated
92	Emergent Herbaceous Wetlands	Wetlands
42	Evergreen Forest	Forest/Vegetated
23	High Intensity Commercial/Industrial/Transportation	Urban
21	Low Intensity Residential	Residential
43	Mixed Forest	Forest/Vegetated
11	Open Water	Water
85	Other Grasses (urban/recreational; e.g. parks, lawns)	Open Land
81	Pasture/Hay	Pasture
32	Quarries/Strip Mines/Gravel Pits	Other
82	Row Crops	Cropland
33	Transitional	Other
91	Woody Wetlands	Wetlands

Table A-2. Land use distribution within the watersheds of the 303(d)-listed segments.

TMDL classification	Description	Big Coldwater Creek (acres)	Big Juniper Creek (acres)	Blackwater (acres)	East Fork (acres)	Manning Creek (acres)	West Fork (acres)
Portion of the watershed in Florida							
Urban	Airports	899	0	0	0	0	0
Water	Aquaculture	4	0	0	4	0	0
Wetlands	Bay Swamps	0	0	1	0	0	0
Other	Burned Areas	3	0	0	0	0	0
Open Land	Cemeteries	15	4	0	3	0	12
Urban	Commercial and Services	177	71	6	4	63	163
Urban	Community Recreational Facilities	0	24	0	0	0	0
Forest/Vegetated	Coniferous Plantations	31916	11038	3244	8372	1694	12389
Urban	Correctional	12	0	0	0	12	12
Agricultural	Cropland and Pastureland [a]	32150	3482	2789	2894	2786	26412
Wetlands	Cypress	93	11	9	7	0	44
Other	Disturbed Land	25	5	14	0	0	23
Urban	Educational Facilities	42	30	0	1	0	41
Urban	Electrical Power Facilities	30	2	0	0	0	30
Urban	Electrical Power Transmission Lines	134	30	0	5	1	129
Wetlands	Emergent Aquatic Vegetation	0	0	3	0	0	0
Other	Extractive	59	14	22	0	0	52
Agricultural	Feeding Operations	25	0	24	0	0	25
Forest/Vegetated	Forest Regeneration Areas	12025	7316	1724	3721	247	5405
Wetlands	Freshwater Marshes	264	87	29	45	23	202
Open Land	Golf Courses	188	0	0	0	0	0
Other	Holding Ponds	0	2	0	0	0	0
Urban	Industrial	29	0	0	0	0	29
Water	Inland Ponds and Sloughs	162	19	1	0	6	47
Water	Intermittent Ponds	1	1	6	0	0	1
Urban	Junk Yards	1	0	0	0	1	1
Water	Lakes	3	1	0	1	0	2
Urban	Medical and Health Care	24	0	0	0	0	24
Urban	Military	9	0	0	0	0	0

TMDL classification	Description	Big Coldwater Creek (acres)	Big Juniper Creek (acres)	Blackwater (acres)	East Fork (acres)	Manning Creek (acres)	West Fork (acres)
Forest/Vegetated	Mixed Coniferous/Hardwood	5406	4654	2477	1903	158	2657
Residential	Mobile Home Units	5	0	0	0	5	5
Residential	Mobile Home Units, Medium-Density	14	0	5	0	0	0
Forest/Vegetated	Nurseries and Vineyards	0	225	19	0	0	0
Urban	Oil and Gas Fields	41	0	0	0	0	37
Other	Oil, Water, or Gas Transmission Lines	143	78	37	86	0	57
Open Land	Other Open Lands (Rural)	118	22	0	20	0	98
Other	Outside Study Area	1	1	3	1	0	0
Open Land	Parks and Zoos	6	0	0	4	0	3
Urban	Recreational	0	0	2	0	0	0
Urban	Religious	63	10	3	3	16	59
Water	Reservoirs	411	146	482	54	17	338
Residential	Residential, High-Density	3	0	0	0	0	3
Residential	Residential, Low-Density	1206	295	171	118	194	964
Residential	Residential, Medium-Density	1049	53	87	70	143	902
Other	Riverine Sandbars	49	6	4	17	0	1
Urban	Roads and Highways	42	0	0	0	0	0
Other	Sand and Gravel Pits	40	0	0	0	0	0
Other	Sand Other than Beaches	2	0	0	0	0	2
Forest/Vegetated	Shrub and Brushland	782	1139	353	209	67	380
Water	Streams and Waterways	311	160	99	159	0	11
Other	Strip Mines	50	22	0	17	3	23
Urban	Tourist Services	30	41	0	30	0	0
Urban	Transmissions Towers	2	0	0	0	2	2
Urban	Transportation	0	25	0	0	0	0
Forest/Vegetated	Tree Crops	262	26	37	43	17	150
Forest/Vegetated	Upland Coniferous Forests	40,400	43,698	18,526	25,926	1,472	12,342
Forest/Vegetated	Upland Hardwood Forests	308	341	97	95	49	208
Wetlands	Wetland Coniferous Forests	185	15	154	29	36	98

TMDL classification	Description	Big Coldwater Creek (acres)	Big Juniper Creek (acres)	Blackwater (acres)	East Fork (acres)	Manning Creek (acres)	West Fork (acres)
Wetlands	Wetland Forested Mixed	13,967	11,696	3,504	8,161	588	3,737
Wetlands	Wetland Hardwood Forest	2,813	141	659	424	218	2,093
Wetlands	Wetland Scrub Shrub	476	187	101	160	30	272
	TOTAL (= land - water)	145,581	84,792	34,105	52,370	7,825	69,086
Portion of the watershed in Alabama							
Water	Open Water	0	164	60	0		
Residential	Low Intensity Residential	2	1	6	0		
Urban	High Intensity Commercial/Industrial/ Transportation	0	2	19	0		
Other	Quarries/Strip Mines/Gravel Pits	0	10	1	0		
Other	Transitional	169	158	3,008	164		
Forest/Vegetated	Deciduous Forest	142	286	3,114	127		
Forest/Vegetated	Evergreen Forest	5,306	3,912	49,993	5,305		
Forest/Vegetated	Mixed Forest	1,444	702	10,768	1,439		
Pasture	Pasture/Hay	320	221	3,304	316		
Cropland	Row Crops	718	352	3,117	682		
Open Land	Other Grasses (urban/ recreational; e.g. parks, lawns)	1	0	4	0		
Wetlands	Woody Wetlands	0	160	456	0		
Wetlands	Emergent Herbaceous Wetlands	0	0	4	0		
TOTAL		8,101	5,970	73,855	8,034		
GRAND TOTAL		**153,682**	**90,762**	**107,959**	**60,404**	**7,825**	**69,086**

[a]Florida land use classification is "Cropland and Pasture." This classification was included as “agriculture” and then separated to represent both cropland and pasture. To separate into "Cropland" and "Pasture," the ratio of cropland and pasture from the 1997 Census of Agriculture for the appropriate counties was applied to the Florida classification.

Appendix B
Water Quality Data

Table B-1. Water quality data for the Blackwater River

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
02369800	Blackwater River near Bradley, AL	12/29/83	400
		10/17/84	420
		2/13/85	42
		4/17/85	110
		8/14/85	50
		10/23/85	200
		2/12/86	36
		4/9/86	78
		10/22/86	55
		2/11/87	98
		4/15/87	23
		8/12/87	510
		2/10/88	63
		4/13/88	56
		8/17/88	460
		10/19/88	32
		4/12/89	72
		8/16/89	110
		10/17/89	300
		10/18/90	1000
		2/13/91	57
		5/14/91	57
		8/14/91	330
33030018	Blackwater River at Wood Bridge, Hwy 180	7/11/93	60
		10/3/93	10
		1/9/94	20
		4/3/94	10
		7/10/94	20
		1/8/95	400
		4/2/95	70
		7/9/95	60
		10/1/95	10
		1/7/96	90
		4/7/96	50
		7/7/96	60
		10/6/96	5
		1/5/97	130
		4/6/97	40
		7/21/97	40
		10/20/97	130
		1/26/98	20
305921086431501	Blackwater River at Hwy 180	12/7/92	1
		12/7/92	16
		3/8/93	14
		6/14/93	120
		8/9/93	10
		11/17/93	70
		2/17/94	6

		5/19/94	21
		8/24/94	20
33030001	Blackwater River at Hwy 4 near Baker	5/6/80	9
		7/30/80	230
		8/26/80	43
		9/16/80	23
		10/14/80	2
		10/22/80	240
		11/20/80	15
		5/4/81	10
		8/20/81	3600
		4/8/85	90
		10/16/86	70
		2/17/87	290
		1/14/81	20
		6/2/81	10
		11/2/81	40
		1/25/82	40
		4/28/82	100
		7/26/82	40
		8/24/82	70
		12/16/82	2700
		2/24/83	500
		4/18/83	100
		6/16/83	150
		11/22/83	1500
		12/28/83	400
		5/8/84	10
		6/20/84	300
		8/28/84	160
		10/16/84	11000
		12/5/84	1100
		12/19/84	20
		7/15/85	40
		8/26/85	61000
		10/16/85	840
		12/11/85	150
		4/14/86	50
		6/23/86	60
		12/11/86	400
		4/15/87	20
		6/1/87	80
		8/5/87	60
		10/8/87	10
		12/14/87	100
		2/9/88	10
		4/11/88	20
		6/20/88	20
		9/22/88	50
		4/6/89	550
		6/26/89	10
		9/10/89	10
		9/27/89	120
		11/8/89	1480

		3/21/90	60
		4/1/90	230
		4/2/90	80
		6/11/90	370
		7/1/90	70
		9/19/90	80
		11/7/90	30
		1/2/91	30
		1/6/91	20
		5/22/91	20
		7/7/91	390
		7/30/91	20
		8/27/91	420
		11/18/91	30
		12/16/91	50
		1/5/92	10
		2/26/92	1400
		5/27/92	20
		7/5/92	20
		7/21/92	900
		8/18/92	10
		10/20/92	30
		1/3/93	50
		1/20/93	20
		2/16/93	170
		3/20/93	10
		3/20/93	0
		3/29/93	10
		6/22/93	70
		9/7/93	110
		10/19/93	20
		2/15/94	10
		4/18/94	400
		7/19/94	20
		10/10/94	65
		4/12/95	1800
		5/10/95	2500
		6/14/95	10
		7/12/95	200
		8/9/95	70
		9/20/95	10
		10/11/95	40
		11/8/95	120
		12/13/95	20
		1/10/96	40
		2/14/96	20

Table B-2. Water quality data for Big Juniper Creek

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
33030040	Big Juniper Creek at Indian Ford Rd.	1/6/91	70
		7/7/91	20
		1/5/92	40
		7/5/92	10
		1/3/93	80
		7/11/93	210
		10/3/93	10
		1/9/94	10
		4/3/94	30
		7/10/94	60
		1/8/95	510
		4/2/95	80
		4/12/95	800
		5/10/95	3200
		6/14/95	10
		7/9/95	100
		7/12/95	10
		8/9/95	200
		9/20/95	20
		10/1/95	80
		10/11/95	140
		11/8/95	20
		12/13/95	20
		1/7/96	100
		1/10/96	10
		2/14/96	10
		3/13/96	20
		4/7/96	30
		7/7/96	100
		10/6/96	180
		1/5/97	80
		4/6/97	400
		7/21/97	80
		10/20/97	10
		1/26/98	40
		1/26/98	60
304338086535801	Big Juniper Creek at Blackwater River	3/10/92	1200
		6/10/92	200
		9/14/92	36
		11/17/93	360
		2/17/94	50
		5/19/94	140
		8/24/94	24

Table B-3. Water quality data for Big Coldwater Creek

STATION	LOCATION	DATE	FECAL COLIFORM COUNTES PER 100 MILLILITERS
33030030	Big Coldwater Creek, Jct of East and West Forks	7/1/90	10
		1/6/91	10
		7/7/91	450
		1/5/92	20
		7/5/92	10
		1/3/93	40
		7/11/93	90
		10/3/93	10
		1/9/94	10
		4/3/94	20
		7/10/94	60
		1/8/95	90
		4/2/95	40
		7/9/95	40
		10/1/95	140
		1/7/96	20
		4/7/96	60
		7/7/96	540
		10/6/96	60
		1/5/97	100
		4/6/97	240
		7/21/97	60
		10/20/97	10
		1/26/98	60
		8/13/80	75
		8/26/80	430
		9/16/80	43
33030005	Big Coldwater Creek, Hwy 191 near Milton	9/17/80	93
		7/1/90	30
		1/6/91	40
		7/7/91	560
		1/5/92	10
		7/5/92	40
		1/3/93	50
		7/11/93	50
		10/3/93	10
		1/9/94	10
		4/3/94	10
		7/10/94	10
		1/8/95	280
		4/2/95	30
		4/12/95	3900
		5/10/95	2300
		6/14/95	20
		7/9/95	10
		7/12/95	100
		8/9/95	280
		9/20/95	40
		10/1/95	80

		10/11/95	100
		11/8/95	160
		12/13/95	20
		1/7/96	70
		1/10/96	10
		2/14/96	40
		3/13/96	20
		4/7/96	30
		7/7/96	300
		10/6/96	260
		1/5/97	100
		4/6/97	100
		7/1/97	120
		7/8/97	140
		7/15/97	20
		7/21/97	840
		7/22/97	220
		7/29/97	220
		8/5/97	110
		8/12/97	110
		8/19/97	70
		9/2/97	920
		10/20/97	30
		1/26/98	40

Table B-4. Water quality data for West Fork Big Coldwater Creek

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
33030029	Coldwater Creek at Highway 87	8/26/80	230
		9/17/80	460
		7/1/90	20
		1/6/91	110
		7/7/91	1600
		1/5/92	80
		7/5/92	100
		1/3/93	60
		7/11/93	50
		10/3/93	10
		1/9/94	40
		4/3/94	100
		7/10/94	60
		1/8/95	380
		4/2/95	60
		7/9/95	10
		10/1/95	120
		1/7/96	50
		4/7/96	90
		7/7/96	80
		10/6/96	200
		1/5/97	100
		4/6/97	300
		7/21/97	40
		10/20/97	110
		1/26/98	60

Table B-5. Water quality data for the East Fork of Big Coldwater Creek

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
33030003	East Fork Big Coldwater Creek, Hwy 4	9/10/89	30
		4/1/90	30
		7/1/90	40
		1/6/91	10
		7/7/91	80
		1/5/92	30
		7/5/92	10
		1/3/93	70
		7/11/93	220
		10/3/93	10
		1/9/94	30
		4/3/94	10
		7/10/94	20
		1/8/95	280
		4/2/95	100
		7/9/95	10
		10/1/95	40
		1/7/96	40
		4/7/96	10
		7/7/96	200
		10/6/96	300
		1/5/97	80
		4/6/97	160
		7/21/97	20
		10/20/97	10
		1/26/98	20

Table B-6. Water quality data for Manning Creek

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
304809087023201	Manning Creek at Big Coldwater Creek	3/10/92	2800
		6/8/92	75000
		9/17/92	400

Appendix C
Cattle and Septic Loading Rates used in TMDL Development for the Blackwater River Watershed

Table C-1. Failing septic system fecal coliform loading rates used in TMDL development for the Blackwater River watershed

Subwatershed	Fecal Coliform Rate (counts/hr)	Septic Flow (cfs)
Blackwater 1	4913196.10	4.83E-04
Bull Pen	4258640.63	4.19E-04
Blackwater 2	1613548.53	1.59E-04
Blackwater 3	6505703.85	6.39E-04
Rock Creek	4634936.09	4.56E-04
Blackwater 4	901083.83	8.86E-05
Blackwater 5	765438.53	7.52E-05
Oak Creek	2791812.12	2.74E-04
Blackwater 6	1474329.58	1.45E-04
Boggy Hollow	3898614.52	3.83E-04
Blackwater 7	18599.25	1.83E-06
A*	1672062.22	1.64E-04
Blackwater 8	197199.98	1.94E-05
Panther Creek	1272868.14	1.25E-04
Blackwater 9	383868.39	3.77E-05

Table C-2. In-stream cattle fecal coliform loading rates used in TMDL development for the Blackwater River watershed

Subwatershed	Load of Fecal Coliform (counts/hr)	Flow (cfs)
Blackwater 1	149445605.66	4.38E-07
Bull Pen	22578407.95	6.62E-08
Blackwater 2	0.00	0.00E+00
Blackwater 3	23247709.50	6.82E-08
Rock Creek	244559642.52	7.17E-07
Blackwater 4	0.00	0.00E+00
Blackwater 5	6670287.19	1.96E-08
Oak Creek	87534973.72	2.57E-07
Blackwater 6	190647592.32	5.59E-07
Boggy Hollow	395758321.77	1.16E-06
Blackwater 7	145813780.84	4.28E-07
A*	1165668634.57	3.42E-06
Blackwater 8	144698996.58	4.24E-07
Panther Creek	897077617.96	2.63E-06
Blackwater 9	164798603.94	4.83E-07